JUN 18 1913

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the act of Congress March 3, 1879.

VOL. XXX NO. 24 | SAN FRANCISCO, JUNE 14, 1913 | PER COPY, 25 CENTS

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BY ALEXANDER McADIE.

THE ECONOMIC STATUS OF THE STREET CAR SYSTEM OF SAN FRANCISCO.

BY E. K. BLUE.

STEEL TOWERS FOR OVERHEAD TRANSMISSION LINES.

BY ALFRED STILL.

REINFORCED CONCRETE PIPE.

BY B. A. ETCHEVERRY.

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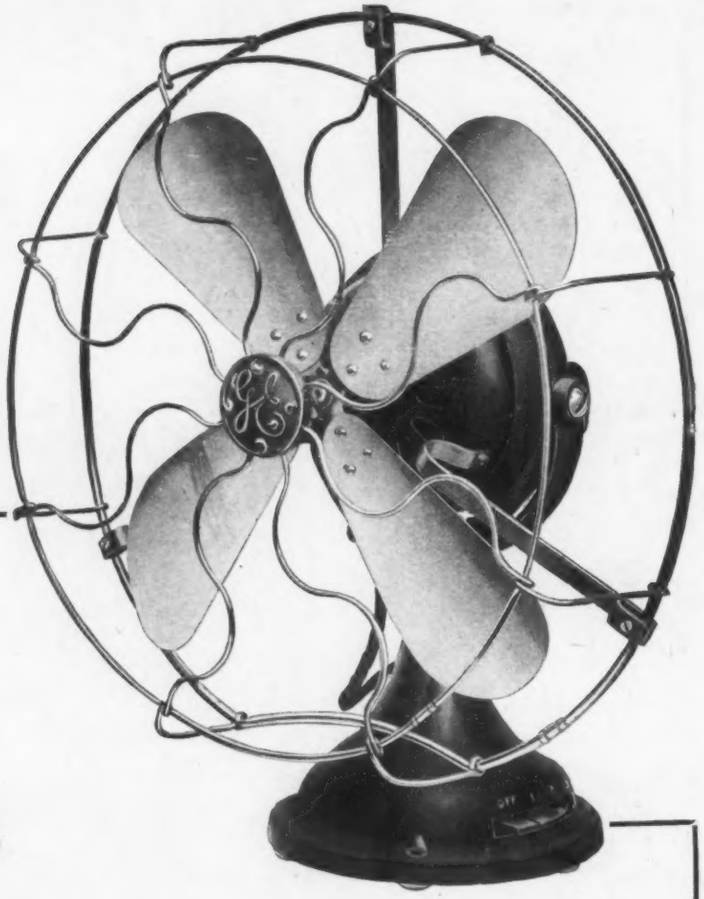

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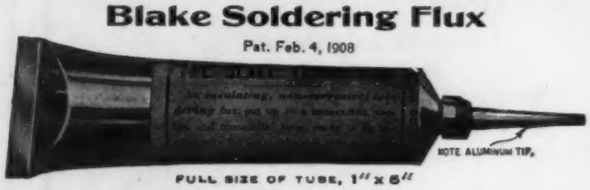

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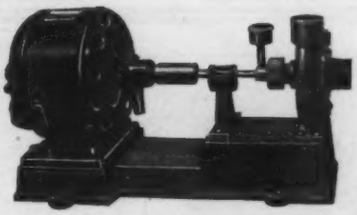

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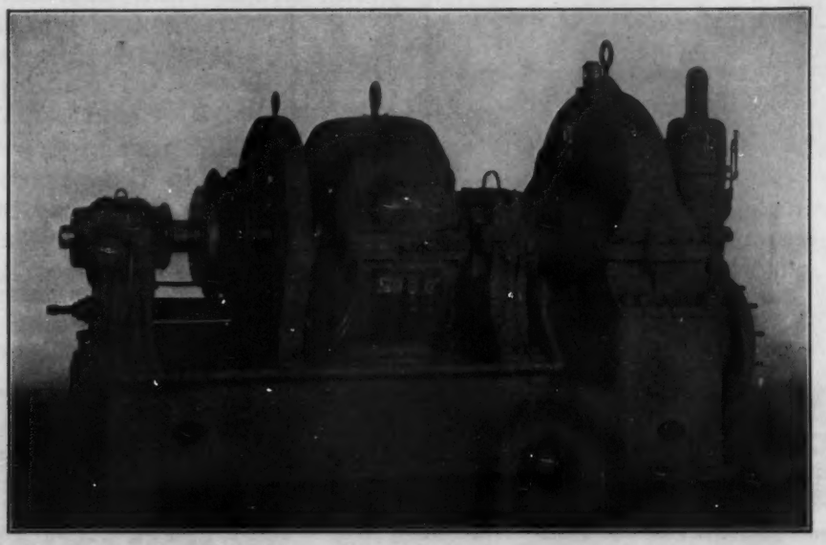

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JOURNAL OF ELECTRICITY
POWER AND GAS
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VOLUME XXX SAN FRANCISCO, JUNE 14, 1913 NUMBER 24

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PROBABLE WATER SUPPLY

BY ALEXANDER McADIE.

There was a pleasing story current in academic circles forty years ago that Agassiz said: "He could not stop his biological work long enough to make money." This is a good team mate to that other tale which comes from the classics, that one Thales (yes, the same man that rubbed amber and thus became the first electrician) was twitted by the citizens of Athens concerning his large stock of knowledge and small stock of money. Now Thales must have been a student of wet and dry seasons, for surmising that the season would be one of abundant rainfall and heavy olive crops, he secured an option on all the presses in Attica. Later in the season when the olive growers found themselves blest with heavy crops, they had to pay whatever bonus Thales saw fit to require.

It is certainly a matter of prime importance to all of us in California to have some advance knowledge of the character of the season as controlling the supply of water available for irrigation, power, stock and other usages. Considering the state as a whole there are certain definite relations between distribution of atmospheric pressure and excess or deficiency in rainfall. Thus the character of the season is found to bear a direct relation to the position and intensity of the so-called centers of action, or in briefer terms,

Fig. 1. Model of Depth of Snow Curve for Various Seasons at Summit, Cal.

the hyperbars and infrabars. Similar relations are known to exist in other parts of the world.

A striking example of this law of seasonal variation occurred in the months of January and February, 1902. During the dry month, January, the deficiency in rainfall throughout California determined by records from 200 stations, was 80.52 mm. (3.71 in.) This meant an actual withholding from the state of 33,000,000 acre feet. Here then was a dry winter month with every prospect of a shortage in water for the coming spring and summer. But what happened? There was a marked change in the position and intensity of the Aleutian low (the infrabar) and the

Continental high (the suprabar) with the result that February was abnormally wet and even in the short month there was an excess of 131.3 mm. (5.17 in.) or practically 43,000,000 acre feet over and above the average for February.

Another remarkable season was that of January, 1909, when nearly twice the average January rain fell in the state, and even at so early a date as the end of January it was plain that there would be no scarcity of water notwithstanding floods, excessive runoff and general waste. February, 1909, was also excessively wet, while March was a month of moderate rainfall.

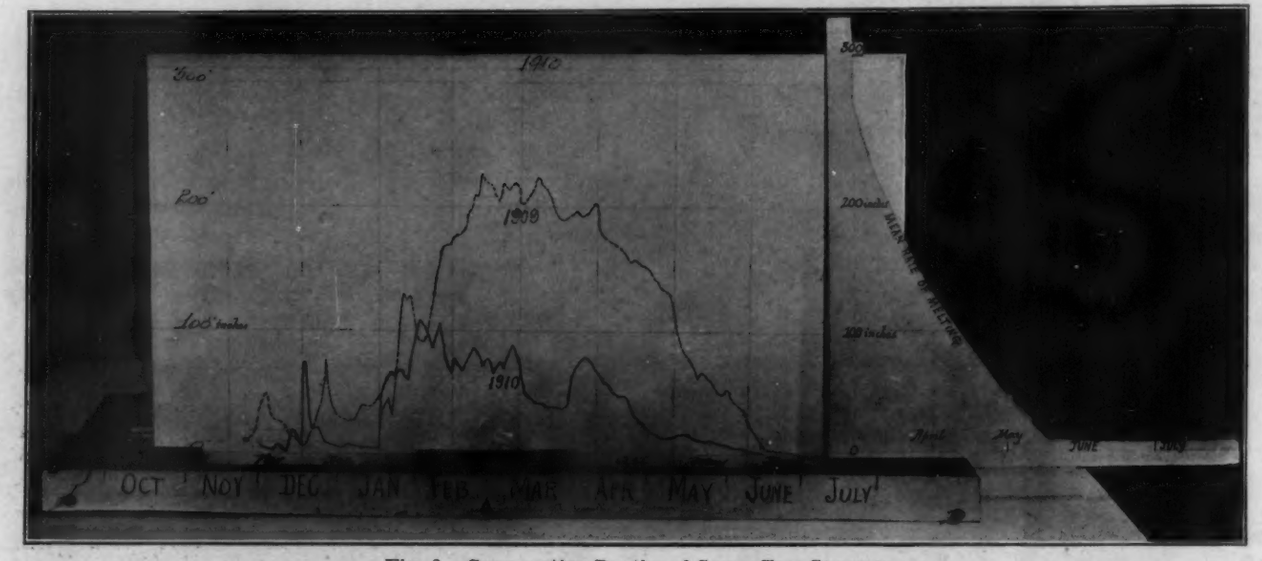


Fig. 2. Comparative Depths of Snow, Two Seasons.

The present season is interesting inasmuch as January was a month of nearly average water supply, while February had only about half and March less than half the normal. Notwithstanding the possibility of rain in June and even July, it is plain that the amount of water which has fallen in the form of rain is insufficient for the general needs and will have to be supplemented from storage supplies or ground sources.

It is also of interest to study the depth and extent of the snow cover in the mountains; and for this purpose records of the depth of snow on the ground at Summit, Placer county, elevation 7010 feet, have been compiled and arranged in such form as to enable comparison between good and bad seasons. In a general way the snow cover is a good index of the character of the season and perhaps the best indicator yet available for forecasting the probable water supply and the river stages. This frozen storage, as John Martin termed it years ago, dissipates in four ways: first, by melting or runoff; second, by evaporation or flyoff; third, by percolation, seepage or sink-off, and fourth, by absorption of forest cover, which for lack of a better name, we may call the holdup. This water of vegetation may be in part re-evaporated from leaf surface, thus constituting what might be called a "second pick-up."

Of these four factors, the second, namely, evaporation, is perhaps the most effective in California. There are certain thermodynamic reasons why a current of air passing over a mountain range loses its load of water vapor in ascending and on the other hand gains heat in descending, thus becoming a desiccating wind, such as the chinook, foehn or familiar norther of our section. Such a wind will carry off snow at an astonishingly rapid rate. Some rough calculations which we have made show that such a condition will reduce the depth of the snow from 8 to 10 in. in 24 hours, whereas the normal rate of melting on a warm but still day, would be but 3 in. And this water does not remain in California.

The first factor, ordinary melting, is effective after the middle of March. In the Journal of Electricity, Power and Gas, March 25, 1911, the writer discussed the probable rate of melting and gave diagrams for comparing the actual rate for any given season with the mean rate, so that the probable date of the disappearance by melting may be determined.

The third and fourth factors can not easily be determined except by systematic measurement; and some steps have been taken toward the accomplishment of this by officials of the Weather Bureau and Forest Service. There has also been some interesting work done by Professor J. E. Church Jr., of Reno, Nevada, in connection with the retardation of melting with elevation in the Tahoe Basin. He uses a combined snow sampler and weighing gage of his own invention for approximate measurement of the water content of the snow under varying conditions of depth and exposure.

For many years the record of the depth of snowfall has been recorded at Summit and card-board profiles, drawn to scale (1 to 40) have been utilized in studying the probable water supply in the central portion of the Sacramento valley, more particularly the watershed of the American River.

It occurred to the writer that it might be possible to utilize the difference between the depths in various years in connection with stream flow measurements for the same period and that such a differential method might enable us to determine what portion of the total depth of snow on the ground disappeared in the form of runoff.

Fig. 1 shows the model in use by the writer for determining the probable water supply based upon depth and extent of snow cover. It is evident that in the two seasons, 1911-12, and 1912-13, the runoff ought to show minima values. Whereas during the seasons 1906-07, 1908-09, 1910-11 there was ample water and runoffs far above the normal. The only available station for comparison is at Fair Oaks. Data given in Water Supply Paper No. 298, U. S. Geological Survey, are as follows:

Total runoff in acre feet:

1912-13 to date..1,000,000 (estimated)	1908-09.....4,540,000
1911-12.....1,160,000, incomplete	1907-08.....1,450,000
1910-11.....6,480,000	1906-07.....5,710,000
1909-10.....3,540,000	

From the snow depth record one is reasonably certain that the present season in the matter of runoff will resemble the season of 1911-12.

Some monthly comparisons are:

	Acre ft.		Acre ft.		Acre ft.
Jan.	1907.. 255,000	Feb. 1907..	822,000	Mar. 1907..1,520,000	
	1908.. 160,000	1908..	113,000	1908.. 202,000	
	1909..1,490,000	1909..	861,000	1909.. 397,000	
	1910.. 524,000	1910..	291,000	1910.. 646,000	
	1911.. 855,000	1911..	589,000	1911.. 799,000	
	1912.. 68,200	1912..	44,800	1912.. 118,000	

Instead of depth of snow a truer measure of the runoff is the total precipitation, which includes rain and snow. The reduction factor generally used is 10. Of course the relative density of the snow is and always must be an uncertain quantity depending upon the age of the cover, the wind action in packing, the temperature factor and the original conditions of congelation. In the data under consideration the writer by actual measurement, melting snow samples in a cover 12 ft. deep, found that it required about 20 in. of the loosely packed snow, freshly fallen, at the top of the cover to make 1 in. of water; while 4 in. of the snow, which was almost ice, taken from the bottom of the snow cover, made 1 in. of water.

The following are the total precipitations:

	Inches.		Inches.		Inches.
Jan.	1907.... 13.50	Feb. 1907....	4.38	Mar. 1907....	27.36
	1908.... 3.50	1908....	4.50	1908....	10.20
	1909.... 29.44	1909....	8.94	1909....	4.60
	1910.... 8.60	1910....	5.10	1910....	4.98
	1911.... 28.90	1911....	5.30	1911....	10.63
	1912.... 3.24	1912....	0.46	1912....	6.10
	1913.... 13.60	1913....	2.05	1913....	3.20

The following notes are of interest in connection with the measurements:

February, 1907—Snow very wet.

March, 1907—Snow abnormally heavy.

January, 1908—A marked decrease in precipitation at levels above 3000 ft.

January, 1909—Abnormally heavy rain and snow. Also heavy runoff, possibly due to saturated condition of ground.

January, 1911—Unusually heavy precipitation, but runoff light. Notwithstanding the fact that more rain fell in the drainage basin of the Sacramento valley than during any previous January, the water courses were much below the normal. The explanation of this is that the rains were mostly in the nature of warm showers. There was less precipitation in the mountain sections than at sea level. Moreover, the precipitation in the mountain sections did not equal that of January, 1910.

One interesting and new factor comes out of this discussion, namely, that in certain storms in California there is not the usual increase in amount of precipitation with elevation; but on the contrary a maximum rate prevails below the 1000-meter level. Ordinarily the precipitation increases with elevation up to nearly the 2 kilometer level. This is of some importance in connection with the selection of reservoirs.

THE ECONOMIC STATUS OF THE STREET CAR SYSTEM OF SAN FRANCISCO.

BY F. K. BLUE.

(Continued.)

Operation by the United Railroads, With Adequate Service.

If the present franchises are operated with adequate equipment and service as recommended by Mr. Arnold, an immediate additional investment of $7,000,000 and a somewhat greater investment in betterments until the franchises expire will be required. The operating expense must also be increased. Under such conditions it is estimated that the total physical investment would amount to $39,000,000, and that the property would be maintained permanently in such a good operating condition that it could be liquidated at three-fourths of its value as the franchises expire. The present worth of the total investment of $18,000,000 required for betterments under these conditions is $13,500,000, which added to the present tangible value of $21,000,000, makes $34,500,000 as the present value of the cost of the whole required investment.

The total gross earnings of the company is assumed to be as before, but with improved service the cost of operation is assumed to require 67 per cent of the gross receipts (see Report, p. 84). This will leave a net income of 33 per cent of the gross receipts, which would amount to a total of $91,560,000 during the 40 year period. The present value of these income items as distributed over the period is $44,570,000. Three-quarters of the physical investment would amount to $29,250,000, the present value of which, as liquidated at the expiration of the corresponding franchises, would amount to $7,360,000. Adding this to the present value of the income we have $51,930,000 as the present value of all the resources of the property. Subtracting $34,500,000, the present value of the required investment, we have $17,430,000 as the present value of the franchises under conditions of adequate service and equipment. This represents the present value of the free gift that was made to the street car companies provided a reasonable service is secured but a lower fare cannot be required. This franchise value represents 13 per cent of the gross receipts, so with adequate service all franchise value would be destroyed by the reduction of the fare to 4.35 cents. With the present service all franchise value would be eliminated if the fare were reduced to 3.86 cents.

Operation of Whole System by a Private Company, With Adequate Service.

According to Fig. 2 the whole physical investment for the complete street car system of the city which would be required by the year 1952 when the last of the present franchises expires would amount to $131,000,000. The present value of the future betterments required to complete this system is $40,250,000, which, added to the present tangible value of $21,000,000, amounts to a present value of the required cost of the whole system of $61,250,000.

The total gross receipts for the complete system for 40 years is estimated at $970,060,000. Allowing 67 per cent of the gross receipts for adequate service, as before, the total income during the 40 years would

amount to $320,170,000, the present value of the items of which is $91,550,000.

Assuming the property to be maintained at three-fourths of its cost, as before, its physical value in 1952 would be $98,250,000, the present value of which at 6 per cent interest is $9,550,000, which, added to $91,550,000, the present value of the income items, amounts to $101,100,000, which is the present value

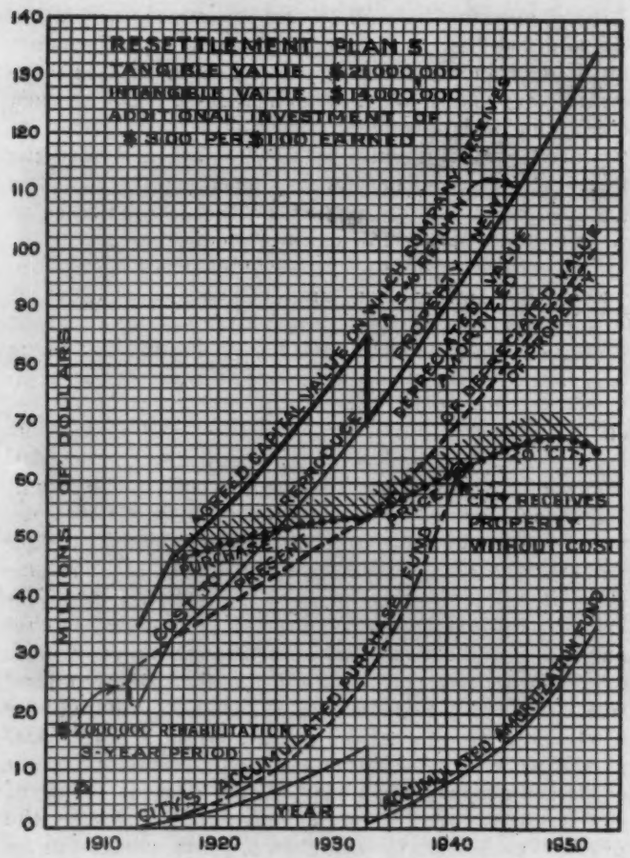


Fig. 2. Profit-Sharing Resettlement Plan 5.

of all the resources of the entire street railway system of the city for forty years at 6 per cent. This is not far from its present value in perpetuity, since the present value of a perpetual annuity at 6 per cent is but 11 per cent greater than the present value of the same annuity for forty years.

Subtracting the present value of the required investment, we have $39,850,000 as the total present franchise value of the complete street car system of the city for forty years at 6 per cent, under conditions of adequate service.

Operation by the City of That Part of the Complete System Not Covered by the Present Franchises.

The investment required by the city is taken as the difference between the investment required for the complete system and that required by the United Railroads under conditions of adequate service, to which is added the amounts liquidated by the United Railroads, at three-fourths of cost, at the time of the expiration of their franchises. The total amount of these items of cost is $121,250,000 for the 40 years, the present value of which is $34,150,000.

The gross receipts is likewise taken as the difference between the gross receipts from the whole system and the receipts estimated for the United Railroads. The estimate for the cost of operation, however, must be increased on account of charter requirements in regard to wages and hours. An examination of the present distribution of operating expenses, as shown in Table 31 and in the discussion on page 387), shows that under charter conditions the wage expense of operation would be increased about 50 per cent. This would increase the total operating expense from 67 per cent to about 78 per cent of the gross earnings, leaving 22 per cent for net income. At this rate the total income to the city during the 40 years would amount to $152,520,000, the present value of which would be $31,340,000. This present value is proportionately smaller than in the case of the United Railroads not only on account of a difference in labor conditions but also on account of the greater part of the income accruing much later in the period.

Since the city would have acquired the complete system at the end of the 40 years the present value of the system depreciated to three-fourths of its cost would be $9,550,000 as before. Adding this amount to the present value of the income we have $40,890,000 as the present value of all the resources for 40 years of that part of the entire street railway system not covered by the present franchises.

Subtracting the present value of the required investment, we have $40,890,000—$34,150,000 = $6,740,000 as the present franchise value to the city of that part of the complete street car system of the city for forty years that is not covered by present franchises, when operated under the conditions required by the city charter.

Whole System Operated by the United Railroads Under the Proposed Charter Amendment No. 34.

Under the conditions of "Resettlement Plan 5" shown in Fig. 2, and recommended by Mr. Arnold, the United Railroads must invest $7,000,000 in three years to rehabilitate the property, and must thereafter keep the investment at three times the amount of the yearly gross receipts. The present tangible value of the property is assumed to be $21,000,000, to which the amounts for rehabilitation, betterments, and extensions are added to form the value of the tangible investment. For the first 20 years $14,000,000 is constantly added to this tangible investment to form an "agreed capital value" upon which a prior return of 5 per cent is allowed to the Company before a division of the profits is made. The operating and maintenance expense is assumed to be 67 per cent of the gross receipts, and 3 per cent of the gross receipts is placed in a fund at 5 per cent interest to be used in paying the security holders the $14,000,000 intangible value at the end of 20 years, and then the remainder is placed to the credit of the City towards the purchase of the property. This leaves an income of 30 per cent of the gross receipts from which the prior return of 5 per cent of "agreed capital value" is subtracted, leaving a residual net income which is allotted in the proportion of 55 per cent to the City and 45 per cent to the Company.

The total investment in betterments and extensions required from the United Railroads under this plan would be $110,000,000, the present value of which is $40,250,000, which added to the $21,000,000 present

Operation by	Income Percentage of Gross Receipts. %	Present Value of Net Returns. Millions.	Present Value of Sums Liquidated. Millions.	Present Value of Total Income. Millions.	Tangible Investment 1912. Millions.	Present Value of Future Investments in Betterments and Extensions. Millions.	Total Present Value of Real Investment. Millions.	Present Franchise Value. Millions.	Actual Interest Rate Realized on Real Investment. %
1. U. R. R. for maximum profit	40	53.99	2.35	56.34	21	5.06	26.06	30.28	13.7
2. U. R. R. with adequate service	33	44.57	7.36	51.93	21	13.50	34.50	17.43	9.4
4. City	22	31.38	9.55	40.89	0	34.15	34.15	6.74	7.3
Total of 2 and 4		75.91	16.91	92.82	21	47.65	68.65	24.17	8.4
3. Complete system by private company	33	91.55	9.55	101.10	21	40.25	61.25	39.85	10.3
5. U. R. R. under resettlement plan	33	69.09	9.55	78.64	21	40.25	61.25	17.39	7.9
City's share under resettlement plan	33	21.38	0	21.38	0	0	0	21.38	∞
Sum under resettlement plan		90.47	9.55	100.02	21	40.25	61.25	38.77	10.2
6. U. R. R. under self-adjusting rate-fixing method	33	70.23	9.55	79.78	21	40.25	61.25	18.53	8
City's share under self-adjusting rate-fixing method	33	21.32	0	21.32	0	0	0	21.32	∞
Total under self-adjusting rate-fixing method	33	91.55	9.55	101.10	21	40.25	61.25	39.85	10.3

Note the franchise value, 24.17, is less than 39.85 on account of difference in labor conditions, and that 38.77 is less than 39.85 on account of amortization fund at 5% interest instead of at 6% in the securities of the company.

physical value makes the total present value of the cost of the investment $61,250,000 as before.

The 5 per cent prior return on "agreed capital value" amounts during the 40 years to $161,800,000, the present value of which is $50,450,000. The net residual income left after taking out the 5 per cent prior return amounts to $129,200,000 during the 40 years. The present value of this is $32,810,000, the 45 per cent of which apportioned to the company amounts to $14,760,000. The present value of the $14,000,000 paid to the security holders out of the 3-per-cent-of-gross-receipts amortization fund at the end of 20 years is $3,880,000, and the present value of the three-fourths of the $131,000,000 cost of the investment at the end of 40 years, is $9,550,000 as before. These items added together make a total present value of all the resources for 40 years of $78,640,000.

Subtracting $61,250,000, the present value of the cost of the investment, we have $17,390,000 as the present franchise value to the United Railroads of the complete street car system for 40 years operated under the provisions of the proposed Charter Amendment No. 34 according to the "Resettlement Plan 5" as recommended by Mr. Arnold. The fact that this franchise value is practically identical with that arrived at for independent operation by the United Railroads under conditions of adequate service is purely adventitious and is not in the nature of a check on the estimate since the figure is reached from entirely different conditions.

By the operation of the street car system under a resettlement plan no investment would be required from the city, but it would receive an income of 55 per cent of the residual net income from operation. the present value of which for the 40 year period would amount to $18,050,000. The city would also receive the proceeds of the amortization fund during the second 20 year period which would amount to $34,301,000 at the end of 40 years. The present value of this amount is $3,330,000, which, added to the other income, makes the present franchise value of the city's share of the income under the resettlement plan $21,380,000 with no investment whatever.

The present values that have been mentioned are shown in the following tabulation. It must be carefully noted that the franchise values in all cases represent a fictitious investment at 6 per cent interest in addition to the real investment at 6 per cent interest shown in the previous column.

(To be continued.)

ELECTRIC PLANTS IN THE PHILIPPINES.

Zamboanga will be the first municipality to own an electric light and power plant in the Philippines. The Moro capital has been authorized to float a $100,000 bond issue for establishing the plant.

A bid offering 2 per cent of gross earnings for the government franchise authorizing an electric light, heat, and power company to establish a plant on the Agno River, has been submitted by the Agno River Mining & Power Company to the Executive Bureau at Manila. The bid is in accordance with act No. 2006, passed some time ago, which offers to grant to the highest bidder the right to establish an electric light, heat, and power plant on the Agno River, to supply the city of Baguio and the subprovince of Benguet. The act does not limit the business of the plant to this territory, however, and, if the bid is accepted, electric power and light may be furnished to the surrounding provinces.

RAPID INCREASE IN HYDROELECTRIC PLANTS IN JAPAN.

The number of hydroelectric power plants is increasing steadily and rapidly throughout Japan. The number of companies now engaged in furnishing power has reached 383 and they operate 620 waterpower batteries. The total horsepower developed at the present time is over 2,000,000. The following table shows the increase in hydroelectric companies, and also in the horsepower furnished, during the past 10 years:

Year.	Companies.	Horsepower.
1903	87	148,846
1904	93	238,633
1905	103	285,393
1906	180	1,168,993
1907	244	1,816,611
1908	262	1,872,348
1909	284	1,917,901
1910	321	2,005,438
1911	365	2,075,575
1912	383	2,172,891

STEEL TOWERS FOR OVERHEAD TRANSMISSION LINES

BY ALFRED STILL,
Member A. I. E. E., Inst. E. E.

Although details of design and the proportioning of parts are matters best left to the manufacturer, the general type of supporting structure to be used under given conditions should receive careful attention on the part of the transmission line engineer. The most economical design of tower to withstand the probable loads that it will be subject to, and to satisfy local conditions, including such considerations as transport and erection facilities, is a problem deserving close attention on the part of the engineer responsible for the design of the transmission line. A study of the probable loads to be resisted under the worst weather conditions will enable the designing engineer to specify certain test loads which will ensure that the finished structure will be strong enough to fulfill the practical requirements. The proper value of these test loads and their distribution or point of application should be determined only after mature consideration. The cost of a tower—apart from the height, which is a function of the length of span—is determined largely by the specifications of test loads. A specification calling for tests that are unnecessarily severe, is just as true an indication of incompetence on the part of the designing engineer as a specification giving test conditions that will result in a tower too weak for the actual requirements.

The calculation of stresses in the various members of so simple a structure as a transmission line tower is not a difficult matter, especially if graphical or semi-graphical methods are adopted. If the designing engineer will make sketches of two or three alternative designs likely to fulfill the required conditions, he should be able quickly to calculate the approximate value of the stress in the chief members, and so obtain a rough idea of the relative weights and costs of alternative designs. The danger of leaving the problem entirely in the hands of the manufacturer is that the latter is always tempted to put forward a design of which he has perhaps made a specialty, and which may have given entire satisfaction in practice without necessarily being the best type of structure for the purpose, or being entirely suitable for use under different conditions.

Stresses in Compression Members.

The failure of steel towers under excessive loads is usually due to buckling of one of the main leg angles in compression. There are many empirical formulas in use for determining the loads that struts or columns will withstand. Rankine's formula for determining the unit stress to be used in the calculations of compression members is,

$$\text{Unit stress} = \frac{\text{Load}}{\text{Area of section}} = \text{lb. per sq. in. of cross section of compression member} = \frac{T}{1 + \frac{l^2}{c\,r^2}} \quad \ldots\ldots (1)$$

where T = maximum stress of steel in tension (or in short column in compression) expressed in lb. per sq. in.

l = length in inches of unsupported portion of compression member,

r = least radius of gyration, in inches,

$$= \sqrt{\frac{\text{moment of inertia.}}{\text{area of section.}}}$$

C = a constant.

For mild steel as generally used in tower construction, with an ultimate tensile strength of about 60,000 lb. per sq. in., a factor of safety of 3 (which is usual) would give 20,000 as a safe working stress. The value taken for T in formula (1) usually lies between 18,000 and 30,000. The figure decided upon appears to depend largely on the margin of safety included in the maximum load assumptions. For preliminary calculations the following numerical values are suggested:

T = 25,000.

C = 18,000.

The "straight line" formula, as suggested by Burr, is quite satisfactory provided the ratio $l \div r$ lies between 40 and 200; this last figure corresponds to a length of compression member not exceeding about twenty times the width of flange. This formula is:

$$T_c = T - k\,(l/r) \quad \ldots\ldots (2)$$

where T_c is the allowable stress in the compression member:

T is the unit stress in short columns.

k is a coefficient based on experimental results.

If the strut may be stressed to the elastic limit (about half the ultimate load), the formula can be written:

$$T_c = 26{,}000 - 90\ l/r \quad \ldots\ldots (3)$$

For a factor of safety of 3 and a working stress not exceeding 20,000 lb., the formula becomes:

$$T_c = 20{,}000 - 70\ l/r \quad \ldots\ldots (4)$$

It is recommended that l/r shall not exceed 100 for main members and 120 for lateral or secondary members. The fact that, for a given cross-sectional area, the shape of the section is an important factor in determining the stiffness and ultimate strength of the members in compression, suggests that, where lightness and economy of material are of great importance, the section of structural steel having the greatest moment of inertia per sq. in. of cross-section should be chosen. The standard sections of rolled angles or tees do not necessarily make the most satisfactory or economical struts or columns, and it is for this reason that tubular sections of steel are sometimes used in place of angle sections on transmission line towers. As an example of the relative economy of the tubular form and other forms of section, when used as comparatively long struts, a steel tube 7 in. internal diameter ⅛ in. thick, weighing 10 lb. per ft., will be as efficient in resisting compression as a steel angle 7½ x 7½ in. and ½ in. thick weighing 25 lb. per ft., or as an H beam 8 x 6 in. and ½ in. thick weighing 35 lb. per ft. So large a tube would not be required except in very high towers; a tube from 4 to

5 in. diameter would generally be large enough for the main members of a transmission line tower up to 100 ft. high. The illustration Fig. 1 is from a drawing kindly supplied by Messrs. Stewarts and Lloyds Ld. of Glasgow, Scotland; it represents a tower 146

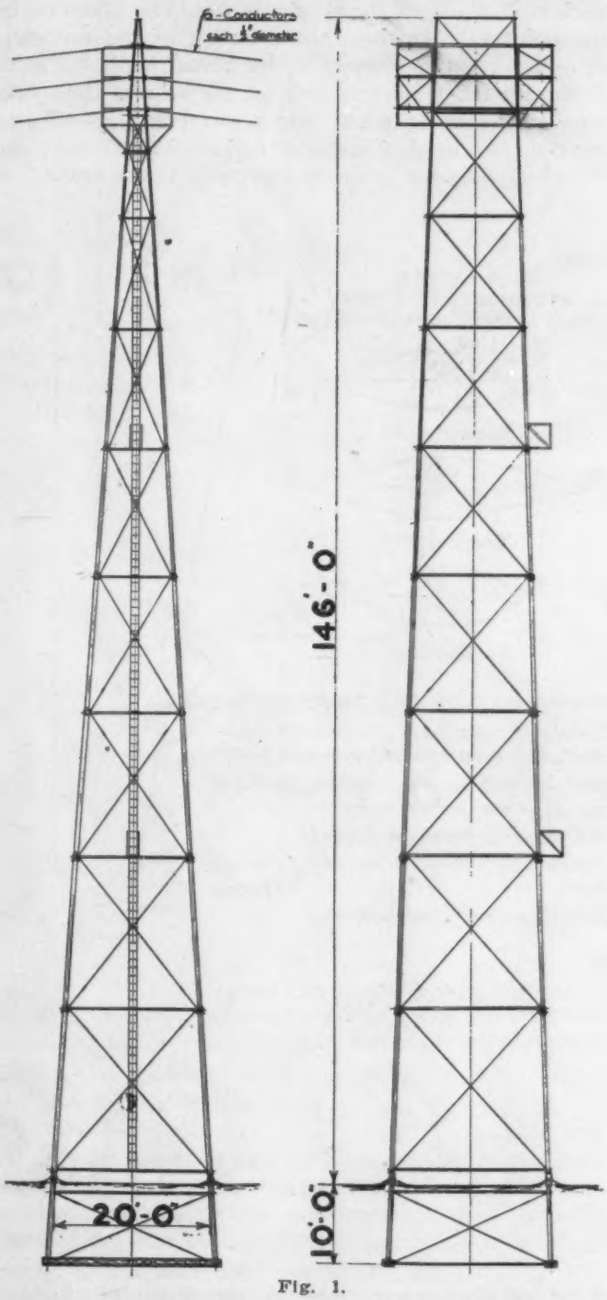


Fig. 1.

ft. high as supplied for a power transmission line in the South of England.

Outline of Usual Method for Calculating Stresses in Tower Members.

The illustration Fig. 2, which is reproduced by kind permission of the Shawinigan Water & Power Company and the Canadian Bridge Company, Ld., shows a typical square base galvanized steel tower as used on the Three Rivers line of the Shawinigan Water & Power Company of Montreal. These towers are designed to carry six aluminum conductors of nineteen strand 200,000 circular mil cable, each being supported by seven suspension disks of the Ohio Brass Company's standard type. In addition to the conductors there are two ground wires of ⅜ in. stranded Siemens Martin steel cable attached to the points (1) at each end of the upper cross arm. The line is built for 100,000 volts.

The method of procedure in calculating stresses is to make a sketch showing the points of application and the vertical and horizontal components of the outer forces. Then indicate by arrows the assumed horizontal and vertical components of the reactions, using the suffixes R and L to indicate the direction or assumed direction of the horizontal components. Since the whole structure is in equilibrium under the influence of the various loads and reactions, it is merely necessary to see that the three following conditions are satisfied at any point considered:

(a) The sum of all vertical force components = zero.

(b) The sum of all horizontal force components = zero.

(c) The sum of all moments about any point = zero.

When taking moments in any particular plane, all those in a clock-wise direction would be considered positive and those in a counter-clockwise direction negative. All joints are considered as frictionless pivots, which assumption is, of course, not strictly correct, especially in the case of riveted joints. It is usually an easy matter to choose a section through the structure in such a position that the stresses in a a given bar can readily be calculated by applying one or more of the three equations of equilibrium.

The sketch Fig. 3 will serve to illustrate the usual method of calculating the stresses in the main members of a tower structure such as the one shown in Fig. 2. The loading considered is that corresponding to the condition of test loads I and V applied simultaneously.

The point at which the horizontal breast pull of 12,000 lb. is applied corresponds approximately with the point 65 ft. above ground level where the corner legs would meet if produced beyond the points (13). The weight of the tower (which it is supposed has not yet been designed in detail) is taken at 4000 lb., and this, together with the test load V, gives a resultant vertical loading of 12,800 lb. applied somewhere on the centre line of the tower.

Consider a section such as X Y, which cuts only three members, namely the leg A at ground level, the leg B just above joint O', and the diagonal brace C.

Select a point O where the members A and C meet, and consider the moments, in the plane of the paper, which are produced round this point by the external forces and the reactions in the members severed by the imaginary section X Y. It is obvious that the stresses in A and C have no effect on the tendency of the part of the structure above the section line to rotate on the point O, and the whole of the externally applied turning moment must be resisted by the stress in the member B. Therefore

$(12{,}800 \times 5.75) + (12{,}000 \times 47.5) + (X \times 11.5) = 0$

from which it is found that X = 56,000 lb.

Since there are two members B taking the whole crushing stress, the total load tending to crush the one member B is 28,000 lb. The length of the unsupported portion of this member is 5.5 ft. or 66 in. The cross-section of $4 \times 4 \times \frac{1}{4}$ in. angle is 1.93 sq. in.; and the least radius of gyration, r = 0.79. The test load should not strain the tower beyond the elastic limit. Using the formula (3), the allowable stress is:

$$T = 26{,}000 - 90 \times 66/.79$$
$$= 18{,}500.$$

This corner member is therefore capable of supporting without permanent deformation a compressive load of $1.93 \times 18{,}500 = 35{,}700$ lb. It should therefore be of ample strength to resist the test load of 28,000 lb.

Turning now to the uplifting force acting in the member A and tending to pull up the foundation, the centre from which the moments are calculated is shifted to the point O' where the members C and B meet. The equation of moments is now

$$(12{,}000 \times 65) + (128{,}000 \times 8) + (X \times 16) = 0$$
$$X = 42{,}300$$

and the tension in one corner angle A is 21,150 lb. The above example briefly describes what is known as the method of moments. It has been assumed that the side of tower considered lies in the same plane as the external forces; but the error introduced is practically negligible. If desired, it is an easy matter to make the necessary correction.

In calculating the stresses in a diagonal member such as C of Fig. 3, the moments would be taken round the point O", which is the junction of the members A and B; but in that case the actual loads on cross arms and the wind pressure on the side of the tower would have to be taken into account and substituted for the concentrated test load of 12,000 lb. at the point O" which does not produce any stress in the brace C so long as the corner angle A remains truly straight and exerts no lateral pressure at the point O. The method of moments can usually be applied for all sections of a tower structure if the imaginary dividing planes are properly placed. The counter members or ties that are not in tension under the conditions of load considered are usually assumed to be non-existent, i.e. to serve no useful purpose as compression members.

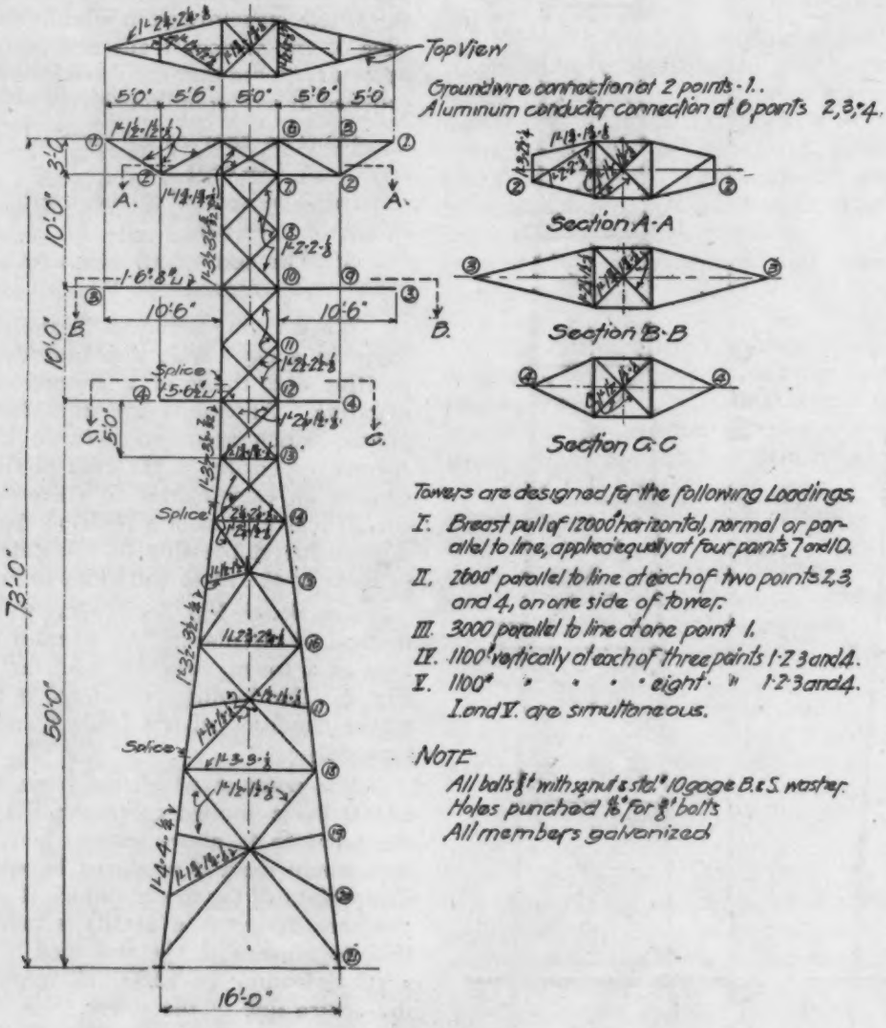

Top View
Ground wire connection at 2 points - 1.
Aluminum conductor connection at 6 points 2,3,4.
5'0" 5'6" 5'0" 5'6" 5'0"
Section A-A
Section B-B
Section C-C
10'6"
Splice
73'-0"
50'0"
16'-0"
Towers are designed for the following Loadings.
I. Breast pull of 12000# horizontal, normal or parallel to line, applied equally at four points 7 and 10.
II. 2600# parallel to line at each of two points 2,3, and 4, on one side of tower.
III. 3000 parallel to line at one point 1.
IV. 1100# vertically at each of three points 1-2-3 and 4.
V. 1100# " " " eight " 1-2-3 and 4.
I and V. are simultaneous.
NOTE
All bolts ⅞" with sq nut & std 10 gage B.&S. washer.
Holes punched 15/16" for ⅞" bolts
All members galvanized

Fig. 2.

Foundations.

The upward pull on the tower legs, which was found in the above example to amount to 21,150 lb., has to be resisted by the foundation. A factor of safety of 2 is usually allowed. The weight of con-

crete may be taken at 140 lb. per cu. ft., and of good earth at 100 lb.; the volume of the earth to be lifted being calculated at the angle of repose, which may be about 30 or 33 degrees with the vertical, as indicated in Fig. 4. If the footing of a tower is in gravel or a

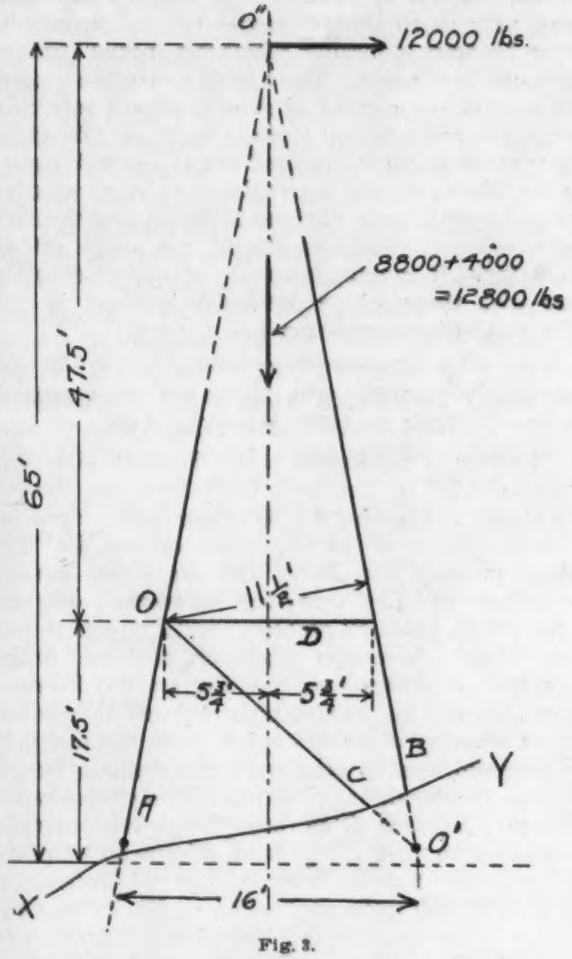


Fig. 3.

mixture of sand and loam tightly packed, there is actually a far greater resistance to the pulling up of the footings than that which is offered by the mere weight of the footings with prism of earth as calculated in the usual way.

When concrete has to be used, it is generally cheaper to reinforce it with steel of an inverted T form, as this makes a lighter construction than a solid block of concrete, and an equally good hold is obtained owing to the increased weight of the packed earth which has to be lifted. At the same time it must not be forgotten that the digging of a large hole five to eight feet deep is considerably more costly than the digging of a hole about two feet square, and this extra cost in erection must be taken account of in designing the footings. In marshy or loose soil or where the right of way is liable to be flooded, special attention should be paid to the design of durable foundations. Concrete footings, with or without piles, or rock-filled crib work may be necessary; it is a matter requiring sound judgment and preferably previous experience on the part of the engineer in charge of construction. Crumbling hillsides are best avoided; it is extremely difficult to guard against damage by land slides or even snow slides when towers are erected on the steep slopes of hills.

The use of concrete adds considerably to the cost of foundations and it should be avoided if possible; on the other hand, it is not easy to design foundations to resist a given uplift without an exact knowledge of the soil conditions at the site of the tower. For the greatest economy of foundation, it is necessary that the designer obtain reliable information on this point.

Assuming an average angle of slope of 30 degrees, as indicated in Fig. 4, and a weight of soil of 100 lb. per cu. ft., the depth of foundation may be calculated as follows:

Let h = depth of footing below ground level,
r = equivalent radius of footing area,
R = radius at ground level of conical section of earth to be lifted.
θ = angle of natural slope of earth.

The volume of frustrum of cone to be lifted is,

$$V = \frac{\pi}{3} h\ (r^2 + R^2 + r R) \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

or, if $r + h \tan \theta$ be put in the place of R,

$$V = \frac{\pi}{3} h\ (3 r^2 + h^2 \tan^2 \theta + 3 r h \tan \theta) \quad \ldots\ldots (6)$$

If $\theta = 30$ degrees, $\tan \theta = 0.5774$ and (approximately),

$$V = \pi h\ (r^2 + .11 h^2 + .58 r h) \quad \ldots\ldots\ldots\ldots\ldots (7)$$

Try $r =$ one foot, and $h =$ seven feet; the volume of earth to be lifted, by formula (7) is then,

$V = 230$, which gives,
$W = 23{,}000$ lb.

As previously mentioned, if the soil is firm, this method of calculation usually gives results well below actual values of pull required to uplift the footing.

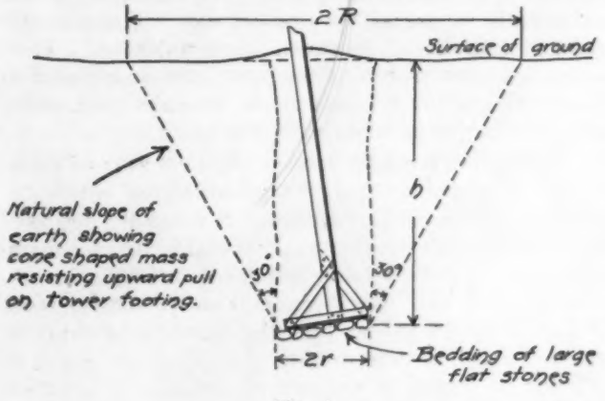


Fig. 4.

Under the conditions upon which this example has been based, it is probable that the footing would not move with a pull appreciably smaller than 30,000 lb.; there would then be a packing of the soil immediately above the footing, and a final pull of about 40,000 lb., might be necessary to uproot the stub and footing.

If the footings are imbedded in concrete, it is well to let the iron-work project through the bottom of the concrete block, to ensure that the tower is properly grounded.

Stiffness of Steel Towers—Deflection Under Load.

The deflection of the top of a transmission line tower of the ordinary light "windmill" type with wide square base, when bolted to rigid foundations and subjected to a horizontal load such as to stress the material to nearly the elastic limit, might be from two to five inches. With regard to the two-legged or "flexible" type of tower, if this is of uniform cross-section it can be treated as a beam fixed at one end and free at the other end. If the resultant pull can be considered as a single concentrated load of P lb. applied in a horizontal direction, at a point H in. above ground level, the deflection, in inches, will be

$$\delta = \frac{1}{3}\frac{PH^3}{MI} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

where M is the elastic modulus for steel (about 29,000,000; being the ratio of the stress in pounds per sq. in. to the extension per unit length), and I is the moment of inertia of the horizontal section of the tower.

Concluding Remarks Regarding Steel Tower Design.

Generally speaking there is a tendency to economize in the cost of steel towers by using sections of structural steel in which stiffness is obtained by making the thickness of metal small in proportion to the other dimensions of the cross-section. It is true that light weight of parts and of the complete tower are important if the advantage of lightness can be obtained without sacrifice of other advantages, the chief of which is durability. When a transmission line is not intended to last longer than 15 or 20 years, these light sections are allowable; but for the more important and costly lines, it is well to avoid the use of metal thinner than ¼ in. for the main members, or than 3/16 in. for the secondary or bracing members. In the writer's opinion it is not wise to use 4 x 4 in. angles for the corner legs less than 5/16 in. thick, although a thickness of ¼ in. is very common in towers actually in use at the present day. The ultimate life of such towers is, however, as yet unknown. Towers made of few peices of comparatively heavy section steel will probably prove more durable than those built of a larger number of lighter parts.

The above remarks concerning thickness of metal are not intended to apply to structures of which the members are of tubular section. If carefully designed and painted when necessary, the metal in tubular members could be considerably thinner than would be permissible with the usual sections of structural steel. In fact it would appear that the slenderness ratio l/r which is used in determining the allowable stress in columns or struts, is not entirely reliable in practice. A symmetrical section such as a tube or H beam, would seem to be more satisfactory than the more common angle section as used in the corner legs of towers.

When considering designs of towers for a long transmission line, special cases will generally arise, requiring special treatment. It is well to avoid if possible a number of different designs, and where the height does not require to be increased, it may sometimes be found more economical to use two standard towers close together for supporting special long spans, or for turning sharp corners, than to design special towers for the purpose. An angle not exceeding 7 degrees can usually be turned on a standard tower. This angle may even be as great as 10 degrees, especially if the length of the approach spans is decreased. In fact by reducing the length of approach spans, very much sharper angles can be turned; but it then becomes a question whether a special structure might not be cheaper. There is an unexplained prejudice against the guying of steel towers where extra strength to resist lateral loads is required. By giving proper attention to the method of guying, and inspecting the line at regular intervals, there is no apparent reason why this fairly obvious device to save the extra cost of special structures should not prove entirely satisfactory; it cannot, however, be expected to find favor with those whose particular business it is to make and sell transmission line towers.

ENTROPY-TEMPERATURE AND TRANSMISSION DIAGRAMS FOR AIR.

"Entropy-Temperature and Transmission Diagrams for Air," by Professor C. R. Richards, has just been issued as Bulletin No. 63 of the Engineering Experiment Station of the University of Illinois. This bulletin presents the theory and use of an entropy-temperature and an entropy-log temperature diagram, by the aid of which all problems pertaining to the expansion and compression of air may be solved graphically; and an air transmission diagram for determining graphically the size of pipe required to transmit a given quantity of air through a given distance with any assumed loss of pressure. The bulletin further discusses the conditions affecting the maximum power which may be transmitted through pipe lines carrying compressed air, and the general efficiencies of power and pressure transmission. Copies of Bulletin 68 may be obtained upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

WASTES OF NATURAL GAS.

The history of the natural gas industry of the United States is an appalling record of incredibtable waste according to Ralph Arnold and Frederick G. Clapp, authors of Technical Paper 38 of the United States Bureau of Mines on the subject, "Wastes in the Production and Utilization of Natural Gas and Means of Their Prevention." The waste of natural gas has drawn the attention of the entire country, and because the waste threatens the life of gas fields it has prevented many investors from building plants in the various fields, thereby depriving the localities of increased population and wealth. The most notorious waste at present is in Oklahoma, Louisiana and California. The commission on the conservation of the natural resources in Louisiana, after an exhaustive examination of the situation in the Caddo field, found that the waste approximated 75,000,000 cu. ft. per twenty-four hours, an amount equal to twenty times what the city of Shreveport uses now in the same space of time and equal to one-twentieth of the amount consumed by the entire United States.

ELECTRICAL PUMPING AND IRRIGATION

REINFORCED CONCRETE PIPE.

BY B. A. ETCHEVERRY.

On the Roswell project, Idaho, the reinforced pipe was the dry mixture, hand-tamped pipe, described further, around which was wound the reinforcing steel wire, which was covered with a rich cement mortar. The method of winding the wire, applying the plaster and laying the pipe is described as follows by Zenas N. Vaughn, the engineer in charge:

"Two movable bulkheads, with crank handles attached, are so arranged that the pipe length can be firmly clamped between them. At a distance back of this device a steel shaft, into which is cut a screw groove, works freely horizontally. Back of this, and horizontal to it, a wooden shaft is placed for regulating the tension of the wire, and still back of this is a vertical spindle, from which wire unwinds automatically. The wire used for reinforcing is a No. 12 gauge, galvanized wire, having a tensile strength between 500 and 600 pounds. A coil of this is placed vertically upon the spindle, the wire is passed around the tension shaft, thence into the screw groove, and is finally firmly attached to one end of the pipe length by soldering. The pipe is then revolved by two men at the crank handle, by which process the wire is wound upon the pipe under a high tension, the spacing of the laps of the wire being made even by the screw groove. Variation in spacing for different heads is accomplished by using pulleys of different diameters, to govern the rate of revolution of the grooved shaft as compared with that of the pipe length. The reinforcing is stressed the same as that in the main pipe.

"When the reinforcing reaches the end of the pipe length, the last two or three laps being made parallel, it is again soldered, and the wire is severed. A steel trowel curved to conform to the shape of the pipe, and suspended above it, is then dropped into place, and cement mortar, 1½ to 1, is run upon the pipe as it revolves, the trowel smoothing this down to a uniform thickness. The bulkheads are then unclamped by a lever at one side, the pipe is removed, and is carried away to be properly cured.

"In the trench the bell and spigot ends of the pipe are fitted together, as in the case of sewer pipe. Around the joint is placed a flexible form, made of very heavy canvas, attached to blocks of wood, sawed out in such a way that a space of about one inch, measured transversely to the pipe, and six inches longitudinally, is left vacant for the reception of the mortar. Along each edge of the form is run a 12-gauge wire, terminating at one end in an iron ring, at the other in a tongue pin, curved in shape, so that when clamped through the ring it draws the wire to a high tension, firmly binding the form to the pipe. The form is then filled with cement mortar, and immediately afterwards the interior of the joint is carefully pointed to insure water tightness, independently of the collar, as far as practicable. As soon as the collar forms can be removed, the trench is backfilled, to protect the collars while curing." (Journal of Idaho Society of Engineers, pp. 40-41, Vol. I.)

In Southern California reinforced pipe built in the same manner has been used. It is wound with No. 12 galvanized wire, spaced about 1½ inches apart, and coated over to protect the wire from corrosion. The cost of reinforcing the hand-tamped pipe is 10 cents per foot for 10-in. pipe, 15 cents for 12-in. pipe, 25 cents for 20-in. pipe, and 35 cents for 26-in. pipe.

Cost of Making and Laying Reinforced Concrete Pipe.

Umatilla Project.—A distinctive feature of the Umatilla project is the irregular topography of the irrigated land, which has required the use on many of the laterals of several miles of reinforced concrete pipe to carry the water over depressions. The pipes have been made in two sizes, 46 in. and 30 in. in internal diameter. The 46-in. pipes are 3 in. thick and made in sections eight feet long. The 30-in. pipes are 3 in. thick and the sections four feet long. The larger size pipes were made at first 47 in. in diameter and only 2½ in. thick. The M line siphon described farther was made of this 47 in. pipe.

The reinforcement consists of a steel wire wound in a spiral made rigid with seven longitudinal rods and cross-laced with small wire, No. 16. The reinforcement is made of different weights, according to pressure. For pressures above 30 ft. up to a maximum of 55 ft. large size pipe is reinforced with 5/16-in. wire, spaced 2½ in. apart. This reinforcement weighs 33 lbs. per lineal foot of pipe; the lighter reinforcement weighs 9 lbs. per lineal ft., and the light reinforcement 7 lbs. per lineal ft. The reinforcement, including labor making the spiral, cost 4½ cents per lb. for the 47-in. pipe and 5½c per lb. for the 30-in. pipe.

The concrete was composed of 1 part cement to 2.3 parts of sand and 3.0 parts of gravel, screened through 1-in. mesh, and rejected on ¼-in. screen. Cement cost $2.25 a barrel, sand $1.00 a cubic yard, gravel $2.65 a cubic yard. The cost of various pipe lines made on this project was:

Line	Inside diameter.	Length.	Maximum head.	Cost of pipe.	Total cost laid, including hauling trench excavation, etc.	Cost of placing and making joints, including material.
R_1	46	9831	110	2.97	4.43	.59
O_1	46	5312	36	2.24	3.86	.48
R_2	46	1284	15	2.24	3.26	
D_1	30	5330	45	1.26	2.25	
O_2	30	3556	26	1.26	2.45	
R_3	30	3645	25	1.26	2.04	.22
R_4	30	1622	18	1.26	1.96	

The following approximate prices, which include the material, the making and laying, but not the excavation of trench and the backfilling, are now prevalent in Southern California:

Diameter, in inches.	Cost in dollars for 25-ft. head.	50-ft. head.	100-ft. head.
24	1.75	2.00	2.30
30	2.25	2.50	3.00
36	2.65	3.10	3.60
42	3.20	3.65	4.25
48	3.85	4.40	5.10

The present prices in Southern California for reinforced pipe made with hand-tamped pipe wound with wire and plastered with mortar, are as follows: (These prices are for pipe laid.)

Diameter of pipe.	Cost per lineal foot.	Diameter of pipe.	Cost per lineal foot.
6-in.	$0.20	14-in.	$0.75
8-in.	.30	20-in.	1.20
10-in.	.40	26-in.	2.00
12-in.	.60		

Advantage and Economy of Reinforced Concrete Pipe.

The great advantage of reinforced pipe is its durability. The first cost, as compared to wooden pipe, is usually a little greater, but its longer life will make its ultimate cost much lower, especially when the pipe cannot be kept constantly full. It has been shown that for a wooden pipe, whose life is ten to fifteen years, the total annual cost to pay interest on first cost, renewal and depreciation, is 15 per cent of the first cost, and for a wooden pipe whose life is 20 to 30 years, about 11 per cent. For a concrete pipe, depreciation and renewal are practically eliminated; therefore interest only, at about 6 per cent, need be considered. Based on these figures, a concrete pipe would be as economical in cost as a wooden pipe, even when the concrete pipe cost about twice as much as the wooden one. The prices of wire-wound wood pipe, good for 50 to 100 ft. head, are about as follows for the Northwest States, where large quantities are used and the prices low:

Diameter of pipe.	Cost per lineal foot.	Diameter of pipe.	Cost per lineal foot.
6-in.	$0.23	16-in.	$0.80
8-in.	.38	18-in.	.95
10-in.	.52	20-in.	1.25
12-in.	.67	22-in.	1.45
14-in.	.64	24-in.	1.60

The prices for wooden stave pipe for 50-ft. head, built in place, are about as follows:

Diameter of pipe.	Cost per lineal foot.	Diameter of pipe.	Cost per lineal foot.
26-in.	$1.80	42-in.	$2.80
28-in.	2.00	48-in.	3.40
30-in.	2.20	54-in.	3.90

For 100-ft. head the prices would be about 25 per cent higher.

Comparing the above prices with those for reinforced concrete pipe, it is seen that there is no great difference in first cost, but if ultimate cost is considered, the economy is in favor of reinforced concrete pipe. However, the use of reinforced concrete pipe is limited to moderate heads, under 100 to 150 ft., and they require careful workmanship and an expensive manufacturing plant. Wooden stave pipes have the advantage that they can be used for higher heads and that they are easily and quickly put together. The carrying capacity of wooden stave pipes is greater than that of concrete or steel pipes of the same diameter.

An approximate comparative cost of steel, wood and reinforced concrete pipe is given below. The steel pipe, which has a minimum thickness of ¼ in., will stand a pressure head of 161 ft. The wooden stave and reinforced concrete pipe will stand a head of 100 ft. The prices for wooden stave and steel pipes are approximate San Francisco prices, no allowance has been made for railroad transportation. The prices include materials, making, laying and joining, but not excavation and hauling.

	Safe head.	Cost.
48-in. reinforced concrete pipe	100	$5.10
46-in. reinforced concrete pipe on Umatilla project, Oregon	110	3.60
48-in. wooden stave pipe	100	4.61
48-in. riveted steel pipe	161	9.00

With concrete pipes it is very necessary to prevent the accumulation of air in the pipe to avoid water hammer. This requires that air valves of ample capacity be placed wherever air will collect in the pipe.

The experience of European constructors indicates that while reinforced concrete pipes are more or less porous and subject to percolation under moderate heads when first constructed, the percolation rapidly diminishes and the pipe becomes water tight. This is well illustrated by the following examples.

Tests of Water Tightness of Reinforced Concrete Pipe.

The Reclamation Service has made tests to determine the impermeability of the reinforced concrete pipe made on the Umatilla project, Oregon. The pipe tested was made of two sections cast in moulds as described above. The pipe was 46 in. in internal diameter and 3 in. thick, reinforced with a double coil of 5/16 in. wire with 1½ in. spacing which is approximately equivalent to a single coil of 15/32 in. wire with 1½ in. spacing. The concrete was composed of 1 part of cement to 1.44 sand and 2 of gravel. To make the tests the sections were joined and bulkheads placed at the two ends. Two types of joint were used. One consisted of a collar case in three pieces, each a little smaller than 1/3 the circumference, and placed around the pipe, then joined and cemented to the pipe. The other form of joint consists of a collar cast in place around the pipe. The results obtained by collecting and measuring the seepage water and reducing the measurements to an equivalent loss per mile were as follows:

1. With joint made of collar built up of three segments: A pressure of 47 pounds per sq. in. caused an average seepage equivalent to .24 cu. ft. per second for one mile of pipe. Pressures of 48 to 50 pounds caused a seepage equivalent to .31 cu. ft. per second for one mile of pipe.

2. With collars cast in place: A pressure of 40 pounds per sq. in. gave an equivalent average seepage of .12 cu. ft. per second per mile. A pressure of 50 pounds gave .42 cu. ft. per second and a pressure of 55 pounds gave .56 cu. ft. per second per mile.

The tension in the steel, assuming that the steel takes all the stress is:

Water pressure lbs. per sq. in.	Head in feet.	Tension in lbs. per sq. in.
40	92	9,000
45	103	10,125
50	115	11,250
55	127	12,375

These tests show that properly made reinforced concrete pipes are practically watertight for pressures as great as 100 ft. head. The tests led to the adoption of reinforced concrete for a pressure pipe 46 in. in diameter, 3 in. thick, 9216 ft. long, under a maximum head of 110. The pipe was completed in January, 1910, and has been entirely successful.

Pressure Pipe for the Aqueduct of Acheres.

This pipe which is part of a conduit used to carry the sewage water of Paris towards the agricultural gardens of Acheres was constructed between 1892

and 1895. Where the pressure is above 72 ft. steel pipe was used; below 72 ft. the pipe is built of reinforced concrete by the Bonna system. From 72 ft. to 50 ft. the pipe is lined on the interior with a steel shell .177 in. thick. From 45 to 50 ft. the steel shell is .137 in. thick and below 45 ft. the pipe has no lining of steel. The length of the reinforced pipe is 4920 ft. and was built of sections 8.20 ft. long and 5.90 ft. in diameter and 4 in. thick, joined with reinforced collars. The concrete used consisted of about 1 part of cement to 2 of sand. The cement was a mixture of quick setting cement with slower setting cement. When the water was first turned in it was found that where the pressure did not exceed 26 ft. the pipe remained dry; for pressures from 26 ft. to 41 ft. there was a little sweating which stopped completely at the end of two months; and for pressures from 41 ft. to 45 ft. the sweating stopped at the end of three months. The price paid for the pipe in place was about $12 a foot for the unlined pipe and $18 a foot for the lined pipe.

The distributing system is about 21 miles long and all pipes are of the Bonna type. The diameters vary from 11.8 in. to 43.8 in., all designed to resist a water pressure of 131 ft. The reinforcement consists of a steel shell .23 in. thick between two reinforced steel skeletons, the whole being imbedded in a concrete shell from 1.37 in. to 2.75 in. thick. The prices paid for the pipes in place were: $4.60 to $5.50 per foot for 43.8 in. pipe, and $.72 to $.85 per foot for 11.8 in. pipe.

The strength of this type of pipe was proved in 1893 when M. Launay, Chief Engineer of Sanitary Works for the Department of Seine, France, tested a pipe 20 in. in diameter and 1.37 in. thick, reinforced with Bonna's reinforcement and a steel lining .04 in. thick. The pipe was designed for a maximum pressure of 66 ft. with a maximum tension in the steel of 11,400 pounds per sq. in. When tested it was submitted to a pressure of 409 ft. without rupture. After the test the pipe was cut open and showed that the pipe remained intact, the adherence between concrete and reinforcement being perfect.

Venice Pressure Pipe (Italy).

This conduit was constructed by M. Bordenave for the Water Company of Venice in 1890. The total length is 4.05 miles, the diameter is 2.625 (31½) and 1.46 in. thick for a head of 23 ft. This pipe has not required any repairs since it was put in. The loss of water by percolation which was at first 195 liters per minute, decreased to 102 liters per minute the fifth day, 71 liters the ninth day, and 8.66 liters in 115 days.

Mery, Pierrelaye and Triel Pressure Pipes.

These pipes are used for the distribution system of the above districts near Paris, and have a total length of 74.6 miles. The diameters of the pipes in inches are 78.75, 43.3, 39.4, 31.5, 23.6, 19.7, 15.75, 11.81. M. Bonna completed the work in eight months, the mean progress being 1640 ft. per day.

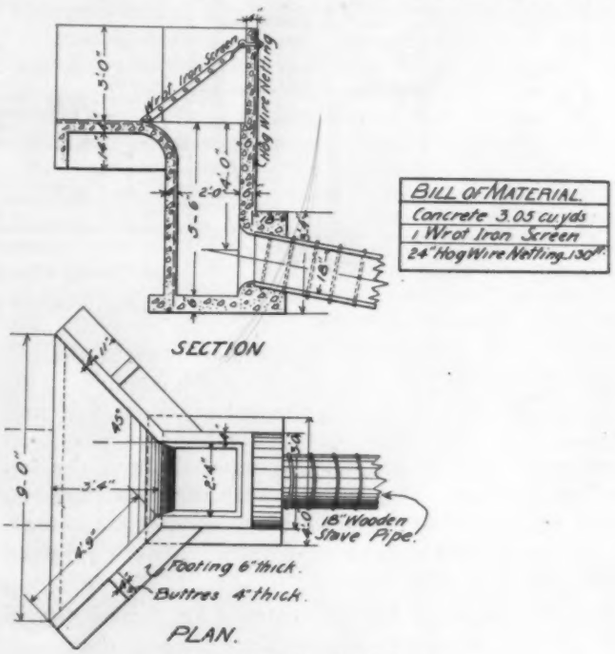
Bone Pressure Pipe (Algeria).

This pressure pipe was constructed by M. Bordenave for the city of Bona, Algeria, in 1893 and in 1895-1896. The total length is 19¾ miles. The diameter is 1.97 ft. and the pipe is under pressure heads of 28 to 79 ft. The reinforcement in both directions consists of steel I bars of the Bordenave type having a cross section of .042 sq. in. and a weight of .142 lbs., with a safe stress of 19.196 lbs., per sq. in. For a pressure of 49 ft. the thickness of pipe is 1.5748 in. and the spiral bars are spaced 3.21 in. apart. For a pressure of 82 ft. the thickness of the pipe is increased to 1.77 and the spacing is changed to 1.91 in. In both cases the longitudinal rods are 3.38 in. apart.

For large size conduits under pressure and especially for those above 5 or 6 ft. in diameter, it is usually more economical to build the pipe in place. While large size reinforced concrete conduits have been used extensively for sewers where the internal pressure is small, their use for irrigation work unless water is very valuable is limited to siphons. It is only in the last few years that such conduits have been constructed. The Reclamation Service has constructed a number of reinforced concrete siphons on many of its projects. On one of them, the Belle Fourche project three large siphons have been constructed. Other notable examples of large size pressure conduits are: (1) Siphon on the River Sesa and Canyon of Ribabona, Spain; (2) Siphon of Albelda, Spain; (3) Clay Creek Siphon. These pressure pipes are described under the subject of siphons.

Inverted Siphons.

Where an irrigation canal is to cross a valley or a natural drainage line the canal must either be run on a contour and the ravine or stream crossed by means of a flume or the depression must be crossed with an inverted siphon. For a long valley or depression a siphon may be much more economical than either a canal following the contours of the ground or



Inlet Chamber to Siphon.

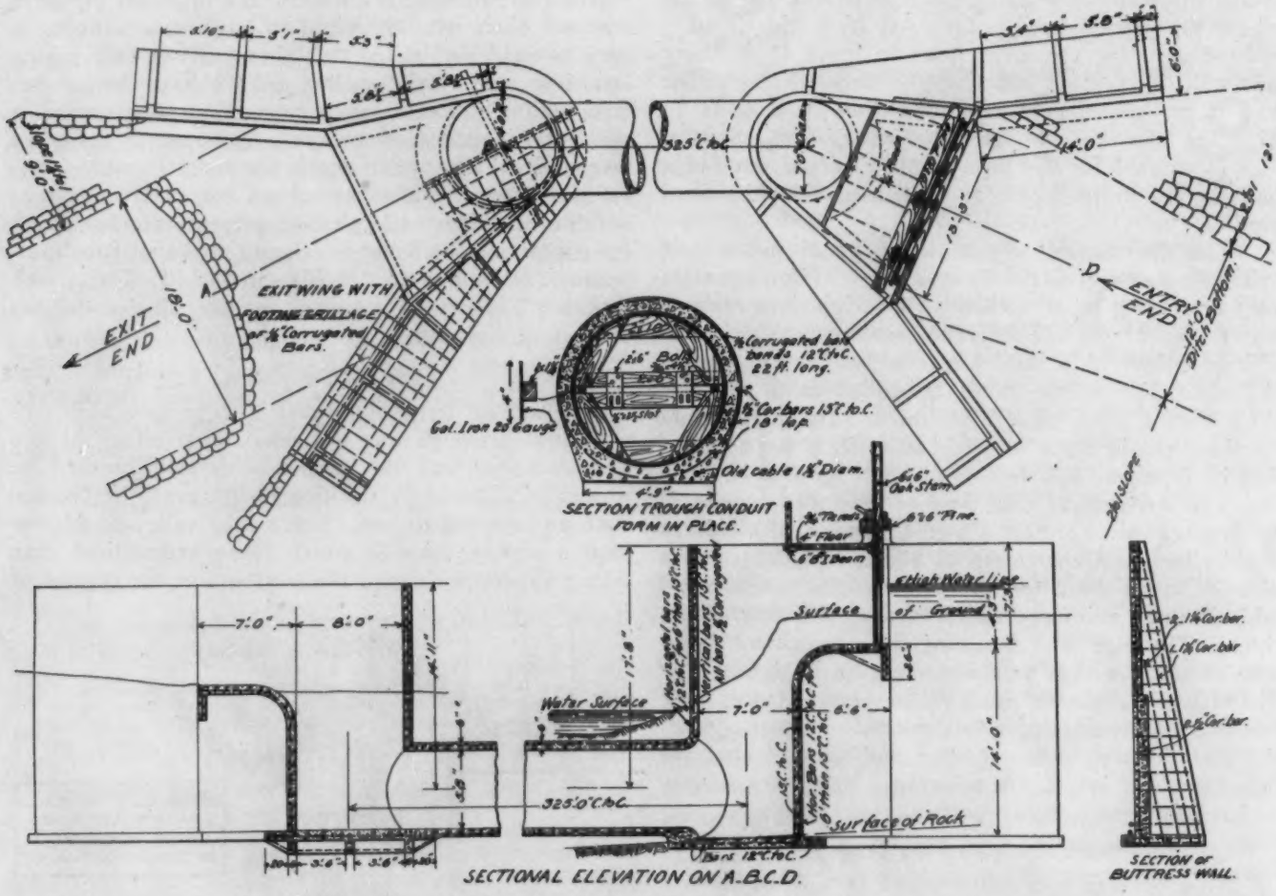
a long flume on trestle. In any case the choice between a canal in earth, a flume or a siphon depends on the comparative cost, the loss in head and the material available for construction.

A siphon consists of one or more lines of conduits connected at their upper and lower ends to an inlet

and outlet. Other accessories to a siphon are: Sand box and wasteway at inlet to permit the discharge of water in case of necessary repairs or break below and to remove heavier sand or gravel. Anchorage or collars used at elbows or bends. Air outlet valves at the convex bends and the high places to permit the escape of air collecting at the bends and summits. Air inlet valves at the summits to permit the entrance of air when emptying the siphon conduit. Blow off valves or discharge gates in the depressions to empty the siphon and in some cases to flush out silt or other material which may collect in the conduit.

The outlet should be designed to diminish the velocity of exit of the water and prevent scouring of the canal below. This may best be obtained by giving the outlet the same form as the inlet and discharging the water at the bottom of a well or by forming a funnel shaped outlet. In either case the water in the outlet above the conduit end forms a cushion and the velocity of exit decreases as it passes from the smaller conduit section to the larger cross section of the outlet basin or well.

One line of pipe or conduit is generally used. For large siphons it may be more economical to use two


EXIT END
EXIT WING WITH FOOTING & RILLAGE of ½" Corrugated Bars.
ENTRY END
Dirt Bottom
Corrugated bars bends 12" C to C. 22 ft. long.
Gal. Iron 26 Gauge
SECTION THROUGH CONDUIT FORM IN PLACE.
Old cable 1¾" Diam.
Oak Stem
Surface of Ground
Water Surface
325'0" C to C.
Surface of Rock
SECTIONAL ELEVATION ON A.B.C.D.
SECTION OF BUTTRESS WALL.

Typical Inverted Siphon Construction.

The inlet should be designed to prevent the entrance of air and floating bodies in the conduit. This is best obtained by placing the end of the conduit well below the water level in the canal. This will keep the larger part of the floating material above the top of the conduit. The larger transported material can also be prevented from entering by using a screen. Gravel and sand may be kept out by providing a sand box and wasteway above the intake. It is only necessary to remove the heavier material for the velocity in the siphon is usually higher than that in the canal. To prevent the loss of velocity head due to entrance the connection with the conduit should be flared. The inlet will consist of the circular or rectangular inlet well and the transition from the canal which may be made with vertical or warped wings. For a wooden stave pipe the inlet is usually made as a rectangular wooden wall.

or more lines. The advantage of several lines is that a break or obstruction in one line will not mean a total interruption in flow. When even a partial interruption of flow would be disastrous, additional parallel lines may be necessary. This is seldom warranted for irrigation systems. To decrease the cost of the conduit the velocity must be made as high as the available fall will permit but not greater than the maximum velocity which the material of the pipe will stand. The pipe is made of steel, wood or reinforced concrete as described above.

GAS APPLIANCES IN JAPAN.

There are about a dozen gas mantle and other fixture manufacturing concerns in Tokyo and three or four in Osaka. The supply of wood for fuel purposes in the densely populated sections of Japan is quite scarce, and gas for heating purposes is becoming more popular.

REPORT OF N. E. L. A. CONVENTION.

General Sessions.

The thirty-sixth annual convention of the National Electric Light Association opened on June 2d with a registration of 3500 members. In many particulars it was the most important convention of the association yet held, especially in the matter of public policy declarations.

The convention and exhibit hall was formally opened in the Medinah Temple on Monday evening with a reception and ball, but the real work of the convention did not start until Tuesday morning, with the first general session, when Hon. L. E. McGann, commissioner of public works of the city of Chicago made an address of welcome to the delegates.

This was followed by President Tait's annual address, in which he reviewed the undertakings of the past year. He stated that the membership is now 12,442, spoke of the harmonizing work of the public policy committee and gave the details of the work of the several sections, committees and officers. He reiterated the suggestion that there should be four vice-presidents to divide the responsibility, recommended a national technical section and recommended a plan to increase the association's income. With regard to rebuilding properties destroyed by great disasters, he expressed the hope that companies will be permitted to refund the expense from the capital account, rather than be compelled to pay it out of surplus or earnings account. He dwelt on the steady decrease in rates, the better co-operation in all branches of the industry and the work of the committee on resuscitation. He concluded his talk with reference to the benefits of consolidating companies and the stability of electric light and power securities.

Secretary T. C. Martin read a telegram from John A. Britton, of the Pacific Gas & Electric Company and a member of the executive committee, in which the Pacific Gas & Electric Company tendered its greetings to the convention and expressed its regrets, owing to conditions, in not being able to have representatives present. It was tacitly implied that the 1915 meeting of the association would be held at San Francisco.

The report of the committee on the organization of the industry showed that the association has 1093 Class A members and 42 company sections.

Secretary Martin's report gave statistics of the detail work handled by the New York office, more than half the $100,000 income being expended in publications. During the past year the association has brought out a new form of statistical report on the subject of rates for municipal commercial lighting, power, heating, etc., and with the co-operation of one of the Class D members a census has also been taken on underground conduit installations.

Mr. W. H. Blood Jr. of Boston, insurance expert for the association, in his report stated that during the year the industry has been comparatively free from annoyance from litigation brought by insurance companies against lighting companies. This is on account of better construction and more careful housekeeping on the part of lighting companies, and also because insurance companies realize the importance and solidarity of the national association. Reductions in rates have been effected, due to the work of the insurance expert and also to the better showing made by lighting companies in the way of fire losses. Mr. Blood reviewed briefly the changes in the National Electrical Code, which were enacted at the meeting held in New York last March, and recommended the employment of inspection bureaus to look over the properties of the lighting companies, both from a fire-hazard and accident standpoint.

The report on progress presented by Secretary Martin dealt with the general conditions of the industry, and its relation to the public. Among these are the questions of conservation; the extension of Public Service Commission regulation; the nature of decisions affecting the industry as to rates and character of service; the advance in engineering in the generating plants; the use in different fields; the development of new fields of activity, as in electric vehicles, ice and refrigeration. Special attention was given to the question of electricity on the farm. A large part of the report was devoted to the relations between the companies and their employes; and many items were noted in regard to educational work, training of salesmen, the development of ideas in welfare work. Another extensive section of the report dealt with the illuminants of the day, discussed their progress, and cited numerous examples of modern practice, particularly with regard to street lighting. Another part of this report, dealing more specifically with questions of power transmission, was presened separately before the Hydroelectric and Transmission Section.

Paul Lupke's paper on "Anticipation" said that the lad who left school because he wanted to fire a boiler and objected to a course which contained too much of the "Lady of the Lake" compressed a large and difficult problem into a few words and little realized that his chances of eventually owning the boiler, instead of being obliged to shovel coal into it indefinitely, would have been materially increased if he had appreciated what a little more schooling would have meant to him.

"Central Station Power in Coal Mines" was the subject of a paper by W. A. Thomas, in which he gave an analysis of the costs in an average isolated plant supplying electricity for mine service, and showed the general character of mining loads and the probable requirements on a tonnage output basis.

"Switching Apparatus for Rural Installations," by E. B. Merriam, stated that recent outdoor switching apparatus has opened to central stations a wide field of application for their service in small towns, mines, quarries, farms, etc., which heretofore had to rely on isolated plants or manual labor.

"Central Stations in Small Towns," by Mr. J. E. Kearns, suggested a method whereby some of the present unprofitable plants may be operated more economically. The scheme in the main is to consolidate several small stations and to distribute energy from one main central station through substations containing modern apparatus.

The report of the public policy committee was presented in open meeting on Wednesday night and as it was signed by the most influential men in the industry, representing an investment of a billion and a quarter dollars it is the most significant of all reports presented. An electrical corporation giving good service at fair prices should be protected against destructive competition in their territory. The committee urges the care of employes as a definite responsibility. Every means should be provided for safety and sanitation. The company should see that the workman gets proper accident compensation. Important rate decisions of the past year are discussed. The committee is ready to advise companies meeting problems of municipal ownership. The proposed New York State hydroelectric development is perhaps the most serious and destructive activity of the moment.

The committee was instrumental in having this bill vetoed by the governor, who advocated the appointment of a commission to investigate the subject. The committee commends the recent movement which has resulted in the organization of commercial educational courses.

In conclusion, our committee recognizes the serious state of public unrest, here and abroad. To a large extent this is of a Socialistic nature. Probably no immaterial part results from the efforts of prosperous agitators who make a business of creating unrest amongst the industrial classes. Much good will be accomplished in continuing our policy of the past in approaching these problems in a spirit of earnest interest, fair

Editor's Note:—The following report, supplementing that in our last issue, gives abstracts of reports and papers and also includes other interesting details of the N. E. L. A. convention just passed.

play, mutual good will and sincere regard for those associated with us in the conduct of our industry—all with a determination to render unto others that which we would have others render unto us.

The committee on resuscitation from electric shock questioned the claims made for the Pulmotor as an efficient mechanism for reviving unconscious subjects and outlined the mechanical method of artificial respiration by pharyngeal insufflation as developed by Dr. S. J. Meltzer.

At the concluding session of Friday, President Tait in the chair, the amendments to the constitution proposed by the committee, of which Mr. F. W. Fruesuff is chairman, were adopted. These provide for foreign members and for four vice-presidents. The report of the nominating committee was presented by Mr. Samuel Insul, which was adopted unanimously and as the result these officers were elected: President J. B. McCall, Philadelphia; vice-president, John A. Britton, San Francisco; H. H. Scott, New York; E. W. Lloyd, Chicago, and E. C. Deal, Augusta, Ga; Treasurer, W. F. Wells, Brooklyn; members of the executive committee for three years: W. C. L. Eglin, Philadelphia; W. N. Ryerson, Duluth; R. S. Orr, Pittsburgh; member of executive committee for two years: Mr. H. C. Abell, Madison, Wis.; member of executive committee for one year: A. C. Einstein, St. Louis.

Mr. Insul escorted President McCall to the chair amid applause. Mr. Tait invested Mr. McCall with the gold badge of office and at the same time a basket of roses from employes of the Philadelphia Electric Company, was handed up to the platform as a tribute to Mr. McCall. The new president spoke briefly and noted the recognition of the younger element in the organization in the new administration.

Mr. W. F. Wells made the report from the committee on the award of the Doherty gold medal for the best paper presented before a company session during the year. This distinction was awarded to Mr. T. E. Bloodworth of the New York's section. Second prize, the Harriet Billings silver medal, went to Mr. Fred Willeby of Denver, and the third, $25 in cash, presented by Mr. Arthur Williams to Mr. A. D. Bailey of the Commonwealth Edison Section in Section.

Technical Sessions.

The report of the meter committee recommended the establishment of a standard dial-face for watthour meters, and discussed the effect of using induction watthour meters on frequencies other than those for which they were designed. The committee concludes that the error accompanying the measurement of energy consumed by flashing signs, welding machines, etc., is so slight as to be practically negligible, falling under 1.5 per cent except in extreme cases. The committee advocated the use of more uniform connection diagrams for instrument transformers. The report also contained descriptions of the latest meter developments and tabular information for the future revision of the "Electrical Metermen's Handbook," 25 to 35-cycle instruments being considered.

A paper on **"The Incandescent Lamp and Its Relation to Lighting Service,"** by R. E. Campbell and W. C. Cooper, discussed voltage drop in interior wiring installations, citing a large number of tests taken at random in various parts of the country, which showed the need of greater attention to the problems of wiring desired in relation to the more extended use of energy-consuming devices.

The committee on overhead line construction presented a report containing full specifications for overhead crossings of electric light and power lines and signaling circuits involving protection against potentials of 5000 volts and over. Valuable material is included regarding sags, factors of safety in line construction, conductors, insulators, poles, foundations, galvanizing, properties of the wire and other data of engineering interest. D. F. McGee, Portland, Ore., cited the difference in local conditions in the northwest and said that it would not be commercially feasible to carry specifications into effect in his territory. Other speakers viewed the material as of great value but chiefly as a working guide.

Commercial Session.

The first commercial session of the convention was called to order in the main auditorium, Tuesday afternoon, by President Tait who introduced Vice-chairman E. W. Lloyd, Chicago. The latter in his official address spoke with satisfaction of the recent work of the Commercial Section, now in its third year, and complimented the various committees on the concrete evidence of results accomplished in the way of publications, co-operative advertising, etc. The work of the committees on "Electricity on the Farm" and the wiring of existing buildings was commented upon. The latter committee has before it a problem difficult of solution in some localities and there is no subject that should receive greater consideration at the hands of electric service companies, manufacturers, dealers and contractors.

In relation to off-peak business, the subject of using electricity for refrigeration was considered. The load factor of this class of business is 50 per cent or greater, averaging 75 per cent for the months from April to October. The encouragement of the electric vehicle business was heartily commended. Many central station companies are not alive to the magnitude of this opportunity.

The finance committee reported total revenues of $5241 received during the past year, divided between the sources of dues and sale of publications. In all $4755 was expended, leaving with the surplus already on hand, a balance of $502.87.

The membership committee reported a present enrollment of 1222 active members. A scheme of organization with state captains is also to be attempted in making a more concentrated membership campaign during the coming year.

"How to Protect Business from Disturbances Caused by Panics" was the subject of a masterly address by David R. Forgan, president of the National City Bank. He prefaced his remarks by demonstrating the mutual interdependency of all modern businesses and the ramifications of the credit system throughout them. He clearly explained how dependent all business is upon credit, showing that except for gold coin all securities, currency and money is simply credit, a promise to pay.

After discussing the disadvantages of the present American banking system and reviewing the recommendations of the National Monetary Commission he showed that the four essentials in bringing our banking system up to date and in providing safeguards against financial stringency are (1) an elastic currency, (2) mobility of reserves, (3) liquidity of bank assets, and (4) the centralization of banking power closely allied to the national government.

The speaker endorsed the proposed National Reserve Association of the United States, which is to be formed through the united action of all the state and national banks of the country which care to come in and can qualify for membership. This great bank will also be the fiscal agent of the government, having possibly three hundred millions of capital, holding the reserves of the banks and having large power in issuing notes redeemable in the national money. As a great central reservoir of reserves it will act as a powerful agency against monetary stringency, and if established along the general lines recommended by the commission will go far toward making panics in the United States as rare as they are in England, France and Germany, where a centralized banking organization, closely allied to the government insures stability and confidence throughout the nation.

Mr. Forgan contended that there is little to fear in such a cenralization and that the assertion that by this scheme Wall Street is seeking to control all the money in the country is beside the mark. The truth is that it is proposed to transfer the control from Wall Street to Washington, from the hands of the private banks to the hands of all the char-

tered banks of the country, with the closest governmental relations. Closing, the speaker urged the united support of business men on behalf of the proposed reform, which will put this country on a level with its largest competitors in this great matter of national and international credit.

The report of the publications committee showed that 187,000 publications had been distributed during the past year, including issues of pamphlets on domestic lighting and service, industrial lighting, street illumination, etc. Of 1300 Class A members in the association, however, only 80, or barely 6 per cent, have taken advantage of the committee's work by ordering these publications for distribution in their own sales campaigns.

The report of the Electric Salesman's Handbook Committee, presented a collection of loose-leaf data. Some 338 compilations of data were prepared during the year just closed, in addition to 64 abstracts; making in all 681 compilations on 175 different industries.

The report on "Education of Electrical Salesmen" discussed in detail the requirements of the successful electrical salesman, which it enumerated as: (1) Thorough knowledge of the customer's problems and how to solve them, (2) good health, (3) enthusiasm, (4) courage, with modesty, (5) imagination, (6) strict regard for the truth, with a reputation for frank, honest dealing, (7) sales temperament, (8) ingenuity, (9) good manners, (10) strict regard for personal appearance, (11) unfailing good humor, affability, pleasing address, adaptation to circumstances, and an intuitive consciousness where perseverance ceases to be a virtue and becomes a nuisance. Descriptions of the courses of training given prospective salesmen by the Chicago Central Station Institute, the New York Edison Company and the large electrical manufacturing companies were included in the report. A list of 57 books was also appended and suggested for the education of salesmen, in addition to the recommendations made for the use of the Solicitor's Handbook and the Cmmercial Section Proceedings as texts for study. The report closed with an abstract of the replies received to nine inquiries directed to representative men in the industry. Discussion turned upon topics of specialization in sales work, remuneration of salesmen by the commission and salary plans, methods of training new men, etc. Several speakers urged that more attention be given the problems of the small plant manager, especially the training of "all-round" salesmen for work in smaller communities.

In a paper on **"Advertising the Electrical Industry by Means of Reading Matter,"** John G. Learned called attention to the commercial value of publicity along other than advertising lines, analyzes the nature and essential features of such publicity, suggests feasible methods for effective results and submits a particular view of the subject for careful consideration by the association and the Society for Electrical Development.

"The Electric Vehicle, the Central Station's Greatest Opportunity," by Edwin E. Witherby, emphasized the desirability of this load from a central station viewpoint. A five ton electric truck with a modern battery would weigh less than a gasoline truck, and that if approval can be found for an electric pleasure car that will only carry one pound of load for every eight to ten pounds of vehicle, it ought to be a simple matter to find approval for trucks where the ratio is one pound of load for every pound of vehicle. In summing up the discussion Mr. Witherby said that over 75 per cent of the central stations of the west are opposed to electric vehicles and that very little development was insured in a territory where the electric light company is entirely neutral.

The report of committee on wiring of existing buildings discussed methods of co-operation between central stations and wiring contractors. In general, the report favors central station soliciting and securing of business, the actual work of construction to be turned over to wiring contractors. This method involves a plan for central stations to quote definite contractor's prices to customers for small and medium-size jobs. A set of units and specifications, the result of estimates and consultations with members from all over the country, suggests unit costs for different kinds of work and list prices which a discount of 50 per cent would give an average net cost. Before anything can be done in the way of standardization of plugs and receptacles, it will be necessary for the industry, including the underwriters, to make a sharp distinction between the articles and devices which should be keep off the lamp sockets while on lighting circuits and, on the other hand, should be kept off both lamp sockets and lighting circuits.

The report of the committee on refrigeration described the various methods of making ice by means of motor-driven apparatus and voiced the desirability of the load from a central station viewpoint. The committee suggested that it is preferable to rate ice making machines in pounds of ice per hour.

Report of rate research committee was confined to a discussion of the existing schedules of some of the larger member companies.

Report of street lighting committee gave data on recent developments in flame ars lamps, which was supplemented by a paper on this subject by W. A. Darrah. A paper on the "Advantages of Copper Clad Wire for Series Arc Lighting" was also presented by T. K. Stevenson.

A lecture on **"Light and Art,"** was given by M. Luckiesch, illustrated by lantern slides, while the sessions were brought to a close with a masterly address on **"Objects of the Society for Electrical Development,"** by Henry L. Doherty.

Accounting Sessions.

The report of committee on "Uniform System of Accounts" brought out very forcibly the fact that all electric lighting industries should take steps towards adopting a uniform sysem of accounts. Public service commissions have already been established in a number of states and the committee anticipates that within the next few years nearly every state in the union will have a commission with power to regulate and control public service utilities and prescribe uniformity in accounting. The committee urges member companies to adopt the uniform system recommended by the association, as this in itself will have much weight in inducing commissions to accept the system. In the discussion it was shown that the system was not applicable to hydroelectric and power transmission companies.

Report of sub-committee on a "Tentative Classification of Accounts, Including Balance Sheet and Indicant Accounts," by John L. Bailey, Consolidated Gas, Electric Light & Power Company. "Handling of Freight Bills," by Albert S. Scott, Public Service Company of Northern Illinois. "Accounting for Replacement of Plant Retired from Service," by Frank A. Birch, Philadelphia Electric Company.

Report of sub-committee on "Statistics and Forms," by C. L. Campbell, United Electric Light & Water Company, and H. Spoehrer, Union Electric Light & Power Company. Paper: "Obligations of the Bookkeeping Department to the Operating Department," by H. Patterson, Rochester Railway & Light Company. Paper: "Handling of Bond Coupons," by W. J. Kehl, Virginia Railway & Power Company.

Hydroelectric and Transmission Session.

Chairman W. N. Ryerson reported signs of a more enlightened conservation policy on the part of the government, public opinion slowly being molded in the right direction. The failure of the New York state hydroelectric scheme by veto of Governor Sulzer was commented upon with pleasure and the balance of the report dealt largely with the evils of overcapitalization, particularly in connection with holding company schemes.

Report of membership committee stated that while the section at the moment totals but 65, a vigorous campaign is afoot for larger numbers. The country has been divided

into four geographical sections with a vice-chairman at the headquarters of each district. Special efforts are being made to bring hydroelectric companies into the organization all over the country.

The paper on **"Failure of Conservation to Conserve,"** by E. H. Thomas, will be published in full in this journal. D. B. Rushmore spoke briefly on the need of educating the public to a real understanding of the situation, and advocated closer connections between citizens and their governmental representatives in dealing with these problems.

The report of committee on progress contained a general review of the events of the year in regard to the question of conservation and cites a number of references, public utterances of national and state officials on the subject, as well as various decisions and actions bearing on the points at issue. Several of the newer plants and systems in the transmission industry are described. Details are given with regard to some of the later projects in this country and Canada, and note is made of various foreign enterprises. Special note is made of the recommendation of official Swedish engineers to use the direct current method for a 200 mile transmission from the Trolhattan Falls to Copenhagen, Denmark, in preference to the familiar three-phase alternating current method.

In the discussion which followed, the excellent efforts of the public policy committee in working against the passage of the New York state hydroelectric scheme was brought out, the speakers being Secretary Martin and Mr. D. B. Rushmore. Dr. C. P. Steinmetz contributed an interesting resume of the relative value of direct current and polyphase transmission, stating that experience and many analyses of propositions show that in the great majority of cases the alterating current method is far superior. The consensus of opinion favoring the alternating current system, Mr. Wright particularly brought out the limitations of commutation in direct current high voltage systems in machines of over 1500 kw. rating.

The report on hydraulic turbines described recent improvements in wheel design and included the consideration of runner wear and material, testing of water wheels and forms of stop and relief valves. The question of runner material for wheels is still open to discussion. Gate valves are no longer necessary in advanced hydroelectric power work. The report contained appendices on the Kingsbury thrust bearing, on water wheel runners and material, and among other material, a paper by Prof. C. M. Allen of the Worcester (Mass.) Polytechnic Institute, on "Efficiency Tests of Waterwheels After Installation."

A paper on **"The New Type of Thrust Bearing"** was presented by Mr. Albert Kingsbury, Pittsburg, on the thrust bearing, of which he is the inventor, with service tests and data. The bearing consists of a rotating collar sliding on stationary supporting surfaces, the whole being flooded with oil. The lubrication is automatic and no high-pressure pumps are required. The bearing is designed to eliminate the objections to vertical shaft turbines. At the close of the paper, Mr. D. B. Rushmore spoke briefly upon the oxidation of turbine blades.

A paper on **"Poles and Pole Preservation"** by R. A. Griffin, gave data on the use and kind of poles, about 700,000 being annually used by electric light and power companies. The author, after describing the various preservative methods maintained that the best method of timber preservation today is the injection of coal tar creosote or dead oil of coal tar into the wood. Any coal tar cresote passing the association specifications can be successfully used; it is only necessary with the brush treatment to apply the preservative to points not over two feet above and below the ground line. Two coats of oil on a 30 ft. butt require about 0.5 gallons of preservative.

A paper on **"Lightning Arresters,"** by E. E. F. Creighton, reviewed the more common apparatus, such as the multigap arrester, the so-called compression chamber arrester and aluminum cell equipment. The use of resistance in series with the cell solves the problem of limiting the charging current to a small value and safeguards the arrester from the effects of heavy dynamic current. A fungus-proof electrolyte has been in use for the past 18 months. The latest practice is to investigate the arrester condition by an ammeter measuring the charging current.

The report on "Operation of Water Power Systems," by Mr. D. B. Rushmore, set forth the efforts now being made to insure reliable and uninterrupted service, touching the efficiency of operating forces, communication, system layout, load characteristics, and water conditions. Practically no hydroelectric development with the capacity of installed apparatus above the rating at maximum stream flow is now built without a steam auxiliary. The general considerations involved in the selection of hydroelectric station apparatus were given considerable space in the report.

"The Keokuk Development" was described by Hugh L. Cooper, in an illustrated lecture.

Report of committee on "Operation of Water Power Systems" emphasized the necessity of reliable and uninterrupted service, and the safe-guarding of the different parts comprising the system. Practically no hydroelectric development with the capacity of installed apparatus above the rating at maximum stream flow is nowadays attempted without a steam station on the system. Consideration must also be given to the causes of disturbances and means for minimizing their effects. These are abnormal or so-called emergency conditions, and in treating of them, the failure of every piece of apparatus and part of the system must be considered as a possibility and a definite plan worked out for limiting the magnitude and area of such disturbances.

A paper on **"Factors Producing Reliability in the Suspension Insulator"** was read by A. O. Austin and one on "Transmission Line Construction" by R. D. Coombs. Dr. S. W. Stratton, also gave on address on "Investigation of Life Hazards of High Tension Lines" by the U. S. Bureau of Standards."

Entertainment.

An elaborate program of entertainment was provided for the delegates and their guests, beginning with the reception and dance on Monday night. On Tuesday afternoon the ladies were given a musicale and tea in the crystal ball room of the Blackstone Hotel and in the evening a colossal circus was given by the Commonwealth Edison Company Section.

On Wednesday afternoon trips were taken to the new Northwest Power House of the Commonwealth Edison Company and the Hawthorne Works of the Western Electric Company. A chamionship baseball game for the Westinghouse cup was played between the New York Edison team and the Commonwealth Edison team, the former being the winners by a score of 6 to 0. The ladies were entertained at the "Pageant of Darkness and Light."

On Thursday the 300 ladies in the party were given a 50-mile automobile trip through Chicago and suburbs, having luncheon at the Hotel Moraine. A large party of men visited the plant of the U. S. Steel Corporation at Gary.

A record-breaking rejuvenation of the Jovian Order was held at the White City on Thursday night, about 200 candidates being initiated into the mysteries of the order. Later nearly a thousand members sat down to supper and enjoyed a cabaret show in the Casino. Jupiter Frank E. Watts was the speaker of the evening.

Exhibits.

A comprehensive exhibit of electrical appliances by the various Class D members in the basement of the Medinah

Temple. By an ingenious and artistic arrangement and decoration a most attractive exhibition was made. In all there were 62 exhibits, comprising 11,000 sq. ft.

At a meeting of the exhibitors the question came up as to whether there should be an independent electrical exhibit at the 1915 convention in Chicago. Chairman J. C. McQuiston stated that he hoped some plan would be worked out whereby the various electrical societies may determine upon dates for holding conventions in 1915 which will make it necessary to make but one trip for many electrical men interested in more than one of the societies.

The general opinion seemed to be that the San Francisco exposition authorities should be urged to provide a separate building for electrical exhibits so that these exhibits may be concentrated rather than scattered throughout the grounds. James I. Ayer offered a resolution, which was adopted, presenting the sense of the meeting that there should be a separate electrical building at the Panama-Pacific International Exposition in San Francisco in 1915. The exhibition committee was instructed to confer with members not present and with other electrical men to see if some action could not be taken to carry out this recommendation.

In relation to the grouping of dates for the San Francisco electrical conventions in 1915, Mr. Gilchrist was appointed a committee to take up the subject with other societies.

Following is a list of exhibits:

Adams-Bagnall Electric Company, Cleveland, Ohio—Flame Arc Lamps. A. J. Selzer, V. N. Marker, C. W. Beach, R. H. Green.

American District Steam Company, North Tonawanda, N. Y.—Models of steam-heating fittings. W. H. Wells, C. R. Bishop, H. C. Kimbrough, B. T. Gifford, A. E. Duram, W. J. Kline, C. A. Gillham, J. A. Bendure.

American Ironing Machine Company, Chicago, Ill.—Electric ironing machines. H. G. Grosse, G. A. Renner, J. L. Mayer.

Bell Electric Motor Company, Garwood, N. J.—Alternating current motors. A. C. Bell, T. R. Bell, A. W. Eckhoff.

Benjamin Electric Manufacturing Company, Chicago, Ill.—Industrial fixtures and lighting specialties. R. B. Benjamin, W. D. Steele, H. E. Watson, A. N. Fox, B. G. Kodjbanoff, F. H. Poss, G. B. Weber, A. E. Lubeck, M. F. Steel, O. L. Johnson.

Century Electric Company, St. Louis, Mo.—Single-phase motors. R. J. Russell, H. A. Porter, E. Kumbo.

Chicago Fuse Manufacturing Company, Chicago, Ill.—Enclosed fuses and conduit fittings. W. E. Finley, A. S. Merrill, W. W. Merrill.

Conlon-Simplex Machine Company, Chicago, Ill.—Electric washing machines. W. J. Conlon, W. T. Haynie.

Co-operative Advertising Service for Central Stations, Chicago, Ill.—Advertising specimens. G. C. Tremaine, R. A. Pick.

Cooper Hewitt Electric Company, New York.—Mercury-vapor lamps. I. B. Carey, G. B. Keech.

Duncan Electric Manufacturing Company, Lafayette, Ind.—Meters and transformers. Thomas Duncan, A. G. Lucas, H. O. Hall, W. H. Sinks.

Duplex Metals Company, Chester, Pa.—Copper-clad wire. S. C. Munoz, T. K. Stevenson, W. D. Ball, W. T. Kyle, W. H. Lipscomb, J. M. Rodger, B. F. Cameron, C. B. Semple, L. M. Garden.

Economical Electric Lamp Works of General Electric Company, New York, N. Y.—Turn-down electric lamps. M. Lobenthal, L. Lobenthal.

Economy Fuse & Manufacturing Company, Chicago, Ill.—Fuses. A. L. Eustice, J. B. Griffith, A. E. Tregenra.

Edison Storage Battery Company, Orange, N. J.—Storage batteries. W. G. Bee, C. B. Frayer, W. C. Andrews.

Electric Appliance Company, Chicago, Ill.—Regulating and protective apparatus. W. W. Low, P. R. Boole, F. J. Alderson, H. Fedde.

Electric Service Supplies Company, Philadelphia, Pa.—Protective devices and line specialties. J. W. Porter, M. A. Berg, O. Mueller, T. H. Henkle, H. H. Johnson.

Electric Storage Battery Company, Philadelphia, Pa.—Storage batteries. G. H. Atkins, T. Milton, T. Cressey, J. Rosholt, E. Kelly, P. Rebel, D. Parker, R. I. Baird, C. Blizard.

Electric Vehicle Association of America, New York, N. Y.—Co-operative advertising for central stations. Harvey Robinson, F. W. Smith, H. E. Niesz, W. J. McDowell.

Electrical Review & Western Electrician, Chicago, Ill.—Electrical periodical. C. W. Price, A. A. Gray, H. S. Tuthill, E. E Wood, J. B. McCarthy, C. W. Borbich, F. R. Schalck, M. G. Lloyd, F. H. Bernhard, H. Ehrlich, J. E. Latta.

Electrical World, New York, N. Y.—Electrical periodical. James H. McGraw, G. W. Elliott, D. T. Pierce, J. A. Kucera, C. T. Walker, Sam A. Hobson, F. E. Watts, H. T. Matthew, W. H. Onken Jr., W. E. Keily, O. H. Caldwell, H. S. Knowlton, A. M. Perry.

Eureka Vacuum Cleaner Company, Detroit, Mich.—Vacuum cleaners. F. Wardell, R. Field, O. B. Schubert.

Federal Sign System, Electric, Chicago, Ill.—Signs, meters, protective devices and transformers. A. R. Gibbons, A. R. Dean, E. E. Rines, R. J. Wherry, W. J. Devine, J. E. McClernon, F. E. Brown.

General Electric Company, Schenectady, N. Y.—Electrical machinery, apparatus and instruments. F. H. Gale, W. H. McLaren, H. L. Monroe, F. H. Vaughen, N. R. Birge, E. E. Gilbert, A. D. Page, E. D. Payne, D. R. Bullen, C. W. Stone, E. W. Rice Jr., W. H. Coleman, F. N. Boyer, A. W. Burchard.

General Vehicle Company, Long Island City, N. Y.—Electric vehicles. P. D. Wagoner, E. E. Witherby, W. J. McDowell, E. W. Curtis Jr., H. W. Hillman, T. W. Barnes, J. S. Gorham.

G. & W. Electric Specialty Company, Chicago, Ill.—Line and high tension devices. C. P. Edmonds, J. M. Hundley.

Hotpoint Electric Heating Company, Ontario, Cal.—Heating devices. J. R. Richardson, M. J. Wolf, H. A. Ross, W. A. Richards, E. W. Donoho.

Hubbard & Company, Pittsburgh, Pa.—Line material. C. L. Peirce Jr., O. W. Youngquist, W. R. Pounder.

Hughes Electric Heating Company, Chicago, Ill.—Electric ranges, stoves and radiators. G. A. Hughes, A. F. Vaughan, G. J. Brucker, A. Smith, C. E. Marsh.

Hurley Machine Company, Chicago, Ill.—Washing machines and vacuum cleaners. N. C. Hurley, T. J. Casey, R. C. Knopke, O. L. Romme, W. A. Murfey.

Innovation Electric Company, New York—Suction cleaners. F. N. Davidson, L. Bourgette.

H. W. Johns-Manville Company, New York, N. Y.—Protective devices, conduit, refrigeration and insulation. J. W. Perry, H. M. Frantz, H. W. Frantz, G. A. Saylor, W. E. Rapp, R. R. Braggins, R. C. Cole, R. F. Massa, R. J. Stewart.

Life-Saving Devices Company, Chicago, Ill.—Resuscitation apparatus. F. T. Fowler, J. N. Giblin, F. T. Fowler Jr.

W. N. Matthews & Bro., St. Louis, Mo.—Fuse switches and line material. W. N. Matthews, C. L. Matthews, W. Bischoff, J. L. Fay, V. L. Crawford.

Metropolitan Engineering Company, New York, N. Y.—Meter protective devices. T. E. Murray, J. E. McClernon, F. E. Brown.

Mineral lac Electric Company, Chicago, Ill.—Maximum-demand devices. H. S. Sines, C. I. Hall, J. Van Buskirk, A. J. Olson.

Moloney Electric Company, St. Louis, Mo.—Transformers. T. O. Moloney, J J. Mullen, L. H. Keller.

National Quality Lamp Division of General Electric Company, Cleveland, Ohio—Incandescent lamps. J. R. Crouse, S. E. Doane, W. M. Skiff, G. S. Merrill, N. H. Boynton, E. J. Edwards, C. W. Bender, Ward Harrison, R. W. Shenton, M. D. Cooper, F. J. Blaschke, R. W. Tavey.

National X-Ray Reflector Company, Chicago, Ill.—Indirect lighting and direct lighting reflectors. A. D. Curtis, H. B. Wheeler, T. H. Aldrich, E. L. Haines, E. E. McKinnie, W. R. Moulton, J. N. Labelle.

Oshkosh Manufacturing Company, Oshkosh, Wis.—Construction tools. J. W. Whooley, R. L. Thayer.

Otis Elevator Company, New York, N. Y.—Elevators. R. W. Charles, H. E. Turner, R. H. A. Carter, E. W. Eaton, E. A. Henderson, E. R. Wilson, H. S. Snead.

Philadelphia Electric & Manufacturing Company, Philadelphia, Pa.—Lighting standards. R. H. Manwaring, W. O. Dale.

Pittsburgh Transformer Company, Pittsburgh, Pa.—Transformers. R. V. Bingay, H. G. Steele, P. H. Butler.

Popular Electricity Magazine, Chicago, Ill.—Electrical periodical. F. W. Harvey Jr., J. A. Harney, H. W. Young, G. T. Hadley, B. E. Blanchard, W. J Wheeler, B. W. Cook.

Sangamo Electric Company, Springfield, Ill.—Instruments and meters. R. C. Ianphier, H. W. Young, J. H. Hodde, A. E Pickard.

John A. Roebling's Sons Company, New York, N. Y.—Wires, cables and fittings. A. B. Conover, W. J. Slingluff, E. H. Christoph, A. V. Erickson.

Simplex Electric Heating Company, Cambridge, Mass.—Heating devices. J. L. Ayer, E. R. Jacobs, D. Rollins, J. H. Johnson, F. L. McKenna.

Southern Exchange Company, New York, N. Y.—Poles and cross-arms. E. G. Chamberlain.

Standard Underground Cable Company, Pittsburgh, Pa.—Wires, cables and accessories. G. L. Wiley, R. B. Wilcox, J. H. Lytle, C. W. Davis, E. J. Pietzcker, R. C. Houck, J. R. Wiley, W. M. Rogers, R. E. Green, E. F. Norton.

Thompson Electric Company, Cleveland, Ohio—Cut-out hangers. A. J. Thompson.

Transportation Committee, N. E. L. A.

Tungstolier Works of General Electric Company, Conneaut, Ohio—Fixtures. G. C. Webster, F. C. Maxheimer, A. B. Wilson, C. F. Reel, J. B. Higgins, W. G. MacMartin.

Valentine-Clark Company, Minneapolis, Minn.—Butt-treated poles. L. A. Furlong, E. L. Clark.

Wagner Electric Manufacturing Company, St. Louis, Mo.—Electrical apparatus and instruments. W. A. Layman, J. Mustard, E. W. Goldschmidt, E. H. Cheney, F. Johnson, A. J. Meyers, J. A. Gelzer, P. L. Lewis, H. E. Griffin, E. M. Webber, W. R. Patton, R. D. Lillibridge.

Western Electric Company, New York, N. Y.—Appliances, line and supply material, telephone apparatus. H. R. King, R. A. Griffin, A. G. Kingman, H. L. Grant, J. F. Sweeney, W. B. Pierce, W. Mueller, J. R. Kearney.

Western Water Supplies Company, Kansas City, Mo.—Electric sterilizers and coolers. P. Thompson, J. H. Thompson.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.—Electrical machinery, apparatus, instruments and appliances. L. A. Osborn, S. L. Nicholson, G. B. Griffin, C. S. Cook, A. A. Brown, M. C. Rypinski, D. E. Drake, H. W. Cope, J. J. Gibson, S. A. Chase, E. P. Dillon, J. C. McQuiston, W. A. Thomas, G. C. Ewing, J. M. Duncan, W. Clegg, C. E. Heise, K. E. Van Kuran, J. S. Tritle, G. S. Vail.

Westinghouse Lamp Company, Bloomfield, N. J.—Incandescent lamps. Walter Carey, T. G. Whaling, B. F. Fisher.

Westinghouse Machine Company, Pittsburgh Pa.—Prime-mover apparatus. E. H. Sniffin.

Weston Electrical Instrument Company, Newark, N. J.—Instruments. G. P. Frey, P. Westburg, R. Johnson.

Wilkinson Company, Chicago, Ill.—Portable lamps. I. A. Jones, R. A. Soukup, O. C. Helm, O. Hoehberg.

GENERAL ELECTRIC COMPANY'S NEW REPAIR SHOPS AND LABORATORY.

BY JOHN HOOD.

The General Electric Company has for several years past realized the desirability of maintaining, as an adjunct to its district engineering department, adequate facilities for carrying on locally the repair and alteration work necessary to ensure effective service to its customers. The repair shop, instituted to meet this condition, has until recently been

Exterior.

located at 942 Bryant street. Due, however, to the increase in the business carried out by this department, the company has found it necessary to secure larger and better quarters wherein work could be properly cared for. At the present

General Interior View.

time a force of 46 men is maintained in the shop and laboratory. This force is now occupying the new two-story brick building at Seventeenth and Kansas streets, which has been designed to meet their special shop and laboratory requirements. The new structure has a floor space of 11,000 sq. ft., The center aisle, 22 ft. wide, is open from the lower floor to the roof to provide for the movement of the 7½ ton electrically operated crane which travels the full length of the building. The crane tracks are extended out four feet beyond the front of the building in order to facilitate loading and unloading trucks at the front door. The crane also runs directly over a pit 8 x 10 ft. and 8 ft. deep, which has been excavated at the rear end of the building to facilitate dismantling large transformers. This pit eliminates trouble which would otherwise be experienced due to lack of headroom in hoisting the windings and core of a large transformer out of the tank.

Winding Department.

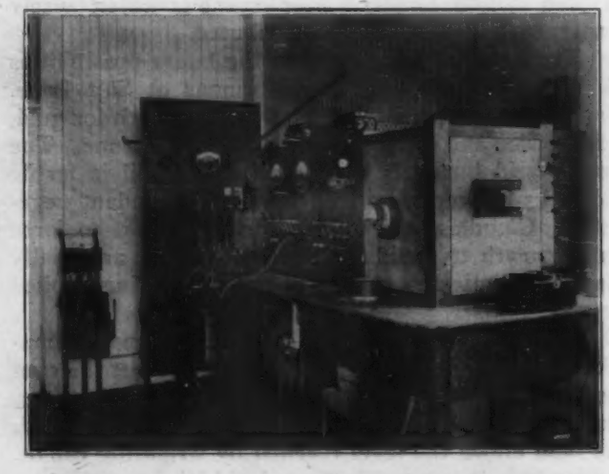
The south wing of the lower floor is devoted exclusively to machine work, the equipment consisting of the usual lathes, planers, shapers, drill presses, etc., necessary for general machine shop practice, and such special tools as are particularly adapted to the class of work handled by the shop. These are driven by direct current motors, each motor

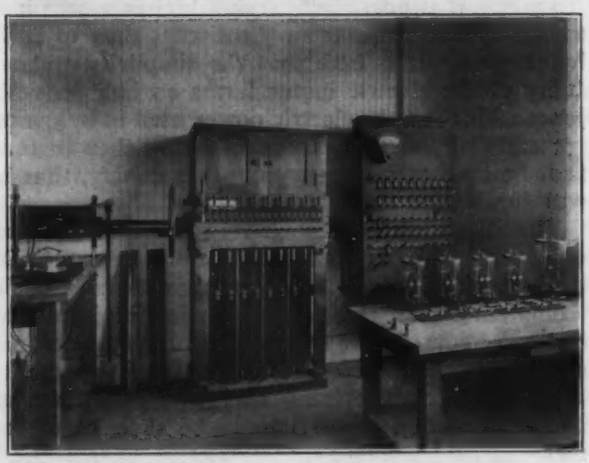
Machine Shop.

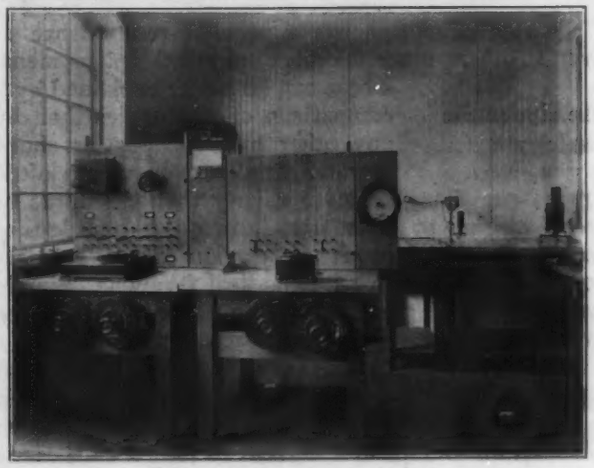
handling a group of machines, the groups being arranged in such a manner as to utilize each driving motor to the best advantage. The equipment is laid out to obtain the best possible light on the work from the windows on the south frontage of the building. This south wing faces on Seventeenth street and has been arranged in such a manner as to give the maximum window area. Excellent light, which

is a prime essential to accurate work, is therefore assured to the shop even on cloudy days. The shop has, however, been carefully arranged for adequate artificial lighting by Mazda lamps and Holophane reflectors to take care of night work.

The north wing of the lower floor is occupied by the office of the shop foreman, tool room, carpenter shop, blacksmith shop, and clothes-locker room. The carpentry and blacksmith work done is such as would ordinarily be carried out







Laboratory Views.

in conjunction with general machine and electrical repair work, including the crating of apparatus for shipment. The south wing of the gallery floor is occupied by the winding and general electrical repair department. This wing is abundantly lighted from the large south windows and a very considerable part of the shop work is carried on here. A suitable equipment is installed at convenient points along the benches for the purpose of testing small motors and other devices. By a simple switching arrangement various voltages both alternating and direct current may be obtained for this work. Motors too large to be handled on the bench are mounted on stands conveniently placed where re-winding and repair work can readily be carried out. Polyphase testing is carried out at the rear end of the building where a special equipment has been installed to conveniently and effectively carry out this work. A vault has been excavated under the Seventeenth street sidewalk and the incoming 2200 volt 2-phase feeders from the power company's line are connected to the special transformers in this room. These transformers consist of two banks, each bank composed of two 25 k.v.a. units, 2200 volts primary, 440/220/110 volts secondary. Suitable taps are brought out from the secondary windings to drum controllers for the purpose of securing any of the above mentioned voltages on either two-phase or three-phase connection. The transformers are arranged in two banks in order that two separate tests may be conducted in the shop at the same time. Each drum controller is mechanically connected to a dial which indicates the voltage and phase at any given position. Transformer taps are arranged progressively, that is 110/220/440 in order that the equipment may be used for starting motors at reduced voltages, advancing from tap to tap by means of the controller until the full voltage is obtained. Switchboard panels, especially designed to permit the plugging in of instruments in order to facilitate testing have been installed thus making the equipment thoroughly complete.

The vault containing the special transformers performs, in addition to isolating the 2200 volts from the main body of the shop, another important function. The portion of the vault nearest the door of the compartment is fenced off from the transformers and is used as a storeroom for paints, oils, varnish and other inflammable liquids. The vault proper is constructed of concrete and brick and has a floor 12 ft. below the level of the main shop floor. This construction is relied upon to isolate any fires which may occur in the inflammable material mentioned. The fact that the vault floor is below the level of the main floor would effectively prevent any burning liquids from running out into the shop. The shop as a whole has been adequately provided with suitable means for protection against fire.

The north wing of the gallery floor is occupied by the Standardizing Laboratory which is equipped to do standardizing and repair work on all classes of instruments and meters. The laboratory has been very carefully laid out in such a manner as to have the repair work isolated from the testing and standardizing instruments, thus avoiding any possible trouble due to dust filings, etc. A complete equipment of primary and secondary standards are maintained as well as special machines and instruments for delicate instrument testing.

A single story building has been constructed on the north side of the main shop, the front 800 sq. ft. of which is used for garage purposes. In this building the electric delivery trucks used by the General Electric Company in San Francisco are housed and charged. The part of the building at the rear of the garage is used as a storage department for special tools and equipment used by the construction force.

The entire plant has been laid out with a view toward meeting every condition likely to rise in connection with such mechanical and instrument work as the General Electric Company handles on the Pacific Coast.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Speeial Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	" "	3.50
Other Foreign Countries within the Postal Union	" "	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advrtisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical. Journal," July, 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1890.

Entry changed May 1. 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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Electrical Irrigation

Sixty years ago the inhospitable wastes of the Great American Desert were regarded merely as a barrier to the prairie schooner and the pony express straining for the Eldorado beyond. Today the rail is the trail and the decapod the ox traversing an inland empire constituting two-fifths of the area of this country and forming the basis of a substantial agricultural prosperity. The transforming elixir in this "before and after" scene is water, wisely conserved and judiciously distributed.

The first people to develop the latent possibilities of the fertile soil were the Mormons at Salt Lake. Many an argonaut, disappointed in his search for gold, did likewise and found a more enduring fortune. The land is arid but it is not desert. The soil is fertile and lacks but moisture to bring forth abundant vegetation. Cloudless skies allow the sun's heat to force plant growth to rapid fruition, and water, artificially supplied, eliminates chance of the crop being spoiled by rain.

Instead of clouds there are snow-capped mountains and ideal reservoir sites that require but the connecting link of the ditch or pipe line to supply water when and where needed. There is, however, much fine land above the level reached by irrigating canals. Even where it is possible to seek a higher source it is often cheaper to pump from the ditches than to build a longer line. It is here that the simplicity and reliability of the electric motor forms an indispensable adjunct. Much of the electric power used in irrigation is generated by water. It seems fitting then in turn that it be used as motive power for pumping, thus in a way liquidating its debt.

The irrigation is of such magnitude and so expensive as to be beyond the scope of private enterprise and consequently there is no finer work being carried to completion than the great irrigation projects that have been undertaken by the United States Reclamation Service. As these are gradually finished, the power companies, supplying energy in districts thus benefited, will find the farmer to be their best consumer.

The Hydraulic Analogy

Water in motion has a peculiar resemblance to several other more complex physical phenomena. These can be better explained by a comparison of similarities than by any other method. Just as short, familiar Anglo-Saxon words often express our thoughts more clearly than do words of Greek origin, so does our intimate knowledge of moving water enable it to explain many subjects more clearly than do mathematical formulae. Simple analogies are of great assistance alike to the novice and to the adept.

One of the most useful is that employed in explaining electrical phenomena, whose intangibility causes it to elude our understanding. The familiar illustration of a man swimming in a current to indicate magnetic deflection, was first used by Ampere. In elementary books the electric current is often likened to water flowing under pressure in a pipe. The resistance of the wire is compared to the friction in the pipe, the amount of current to the volume of water delivered,

and the voltage due to the difference of potential to the pressure due to the difference of water level. One writer has carried this analogy further, representing the inductance of an alternating current by a water-wheel carrying a heavy fly-wheel, the lag corresponding to the inertia of the wheel. He explains condenser and capacity phenomena by means of a chamber with two outlets divided by a flexible rubber diaphragm that stores excess energy.

The hydraulic analogy is also useful in explaining the action of steam in turbines. Just as all hydraulic turbines may be grouped under two main heads of reaction and impulse wheels, so may steam turbines. Hero's turbine, first used by the priests of ancient Egypt, employed the reaction principle, as does also the Parsons, Schulz, and Zolly. Branca's turbine of the seventeenth century was similar in action to the impulse water-wheel, as are likewise the De Laval, Rateau, and Curtis. The impulse turbine, whether water or steam, utilizes the velocity of the moving fluid, while the reaction wheel employs both velocity and pressure. Water pressure is due to head, steam pressure to expansion, which imparts a high velocity to the steam particles and causes them to act on the wheel-vanes so as to produce rotation. The essential principles of the flow of water in pipes have been successfully applied to moving gases, and many other instances will probably suggest themselves to the reader.

An analogy might well be termed an engineer's parable. Both parable and analogy are based upon a simple likeness from which deeper relations may be inferred by comparison. Certain moral truths are made more easy of comprehension by means of parables. Similarly, many scientific facts are more easily understood through analogy. In using this powerful tool, however, there is one precaution to be observed—while phenomena may be analogous, they are not identical, and care should be taken to prevent the idea presented by analogy obtaining so firm a hold on the observer's mind as to blind him to realities. It should be remembered that a comparison is a concession, that it is usually given to supply a lack of technical knowledge, and is to that extent misleading. An analogy is an aid to understanding, but not a substitute for it.

N. E. L. A. Convention

The Thirty-sixth Annual Convention of the National Electric Light Association, now a matter of history, was one of the greatest conventions of its kind ever held. The past thirty-six years have witnessed developments in the electrical world with which no other applied science can compete. Although still in its infancy, electricity today is the most exact of all sciences; mathematical theory and practical application follow each other so closely that results can be predicted with extreme accuracy; electrical measurements can be made more accurately than any others; and there is less guess work and fewer safety factors used than in any other branch of engineering. The capacity of copper cables necessary for a transmission line can be calculated accurately within a small per cent, while the very tower which supports them is often made unwieldy by the guess work employed in its design. That the rapid development made along these lines is due in greater part to the unselfish, co-operative efforts of the National Electric Light Association cannot be denied. The zealous, untiring efforts of this association, combined with the energies of other societies recently organized for the purpose of furthering electrical interests, point to a future even more phenomenal than the past.

The Engineer in the Civic Service

The engineer is so busy with materials that he neglects men. He controls the power of water, steam or gas, but he does not guide human affairs. His judgment is sought on the strength of materials, but is sometimes faulty on the strength of human character. Leadership of men is a specialized business in which the ordinary engineer has not perfected himself, and consequently he is frequently overlooked in political service, especially in the selection of a public service commission which is supposedly made up of "broad-minded men of affairs, who know the community and are beyond the suspicion of corporation influence." This criterion is one reached by many engineers whom we all can name, but unfortunately their qualifications are not known to the political powers. The engineer has not taken the trouble to cultivate the acquaintance of the politician.

He is perhaps no more blameworthy in this respect than the great majority of men, some of whom do not take the trouble to vote. If some men did not make a business of politics, if they did not organize and mold public opinion, it would be but a few years before self-interest would divorce many of us from an interest in community affairs. The political machine is making plans for the next campaign while the reformers are rejoicing over their temporary victory. The regular army usually gets away with the militia.

It therefore behooves the engineer to think and talk of something besides "shop." His training and his experience have eminently fitted him to direct those matters which now concern our government. Many municipalities are issuing bonds for public improvements, sewers, water-works and roads. They are interested in regulation and control of public service corporations. These are functions for whose discharge the engineer is peculiarly qualified .

He will naturally say that his duties are so all-absorbing as to preclude the possibility of his taking an active interest in things political. Civic service is a duty that we owe to the country to which many of us are indebted for our education. In European countries this debt is compulsorily paid in military service. In this land of liberty the service which an engineer can render should at once constitute his duty and his happiness. From the ground of public duty, the engineer should take a more active and practical part in the administration and direction of public affairs. The market price of liberty has ever been the same—eternal vigilance; and if we think our political institutions are worth continuing, it is up to just such men as the engineers to lend efficient service in securing such perpetuity.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

J. B. Lukes returned from Portland this week

B. C. Condit of the Northwestern Electric Company, of Portland, was in San Francisco this week.

C. W. McKillip of the Sacramento Gas & Electric Company, was a visitor in San Francisco last week.

H. G. Behneman, manufacturers' agent, Seattle, is taking a six weeks' trip through the Eastern states, visiting different factories.

Robert Howes, electric and hydraulic engineer, Seattle, has returned from a business trip to Spokane and points in British Columbia.

S. V. Carter, president of the Pacific States Electric Company, left Tuesday evening to spend a few days in Los Angeles and the south.

F. D. Phillips, former City sales manager, has been appointed general sales manager of the Wesco Supply Company, St. Louis, Missouri.

J. H. Kelley, assistant treasurer of the Western Electric Company, Seattle, has been called to San Francisco by the death of his mother.

F. H. Leggett, manager of the Western Electric Company, and Mrs. Leggett, left the early part of the week for a trip to Seattle and the northwest.

P. B. Clapp of Los Angeles reports another Jovian statesman rejuvenation to be held June 13th. About thirty candidates are to be initiated.

J. H. Jamison of the Spokane office, Westinghouse Electric & Manufacturing Company, is spending his vacation at San Francisco and Los Angeles.

O. F. Swenson, engineer with Hunt, Mirk & Company, San Francisco, is making a trip to Portland, Seattle and other cities of the northwest in the interest of his firm.

Percy H. Ridgway, electrical engineer, Seattle, has become connected with the Reynolds Electric Company of that city and will look after the company's steam and power plant work.

John A. Britton was elected first vice-president of the N. E. L. A. This is significant, as the usual procedure follows that he is to be president next year, assuring San Francisco of the convention in 1915.

J. L. Wright of the sales department of the General Electric Company at Seattle and his bride spent a few days in San Francisco en route to Los Angeles, his former home, where they expect to spend the greater part of their honeymoon trip.

S. L. Sheffleton has just returned from Portland, where he has been visiting the White Salmon River power plant recently finished by Stone & Webster. **J. H. Manning**, who was superintendent of construction on this project, is also back at the San Francisco office of the company.

D. F. McGee, chief engineer of the Pacific Power & Light Company, of Portland, Ore., is attending the N. E. L. A. convention. Mr. McGee was one of the organizers and was later president of the Iowa Association. After the convention he will visit the New York offices of the American Power & Light Company, which is interested in the Pacific Power & Light Company. **Lewis A. McArthur**, assistant general manager of the Pacific Power & Light Company, also of Portland, is attending the convention with Mr. McGee.

H. J. Gille, chairman of the Commercial Section of the N. E. L. A. in 1912, has been appointed commercial manager of the Stone & Webster properties in the Puget Sound District, with headquarters at Seattle. Mr. Gille's work in the "business end" of the industry, and his successful connections with the St. Paul Gas Light Company and the Minneapolis General Electric Company, have fitted him admirably for his new responsibilities which will cover the advancement of Stone & Webster service throughout a large portion of the Northwest.

ANNOUNCEMENT.

Pierson, Roeding & Company announce the election of Mr. Thomas Finigan as vice-president of the company, succeeding Mr. Safford K. Colby, resigned. Mr. Colby will continue as a director of the company.

MEETING NOTICES.

Electric Development and Jovian League.

The semi-annual business meeting was held during Tuesday luncheon hour at a downtown cafe, some thirty or more members being present. Treasurer's and reports of the standing and appointed committees of the League were read and adopted.

Report made by the nominating committee appointed at a previous meeting as unanimously adopted follows:

President, W. S. Berry; vice president, W. F. Neiman; members of the executive committee for the term ending June 30, 1914, H. R. Noack, F. J. Cram.

Electrical Credit Men's Association.

The annual meeting was held June 3 at the Stuart hotel, San Francisco, President W. A. Blair presiding. Secretary A. H. Elliott read the annual report, showing operations of the association during the past twelve months.

Addresses were made by W. W. Briggs of Great Western Power Co.; Fred Skeel, Crouse Hinds Co., Syracuse, N. Y.; H. V. Carter and W. L. Goodwin, Pacific States Electric Co.; F. H. Leggett, Western Electric Co.

Members present were Messrs. C. C. Hillis and H. J. Zweifel of the Electric Appliance Co.; A. M. Erwin, R. F. Behan, C. E. Thompson, of Westinghouse Electric and Mfg. Co.; F. G. Beck, Am. Eveready Co.; S. Taylor, Electric Ry. & Mfgrs. Supply Co.; H. Sayles, Holabird Reynolds Co.; H. Von Haggen, Thos. Day Co.; W. M. Levensaler, Dunham, Carrigan, Hayden Co.

The following officers were elected for the ensuing year: President, J. Gray, of Western Electric Co.; vice-president, H. Von Haggen, Thos. Day Co.; executive committee, C. C. Hillis, S. E. Kearny, W. A. Blair.

Los Angeles Section A. I. E. E.

At the annual election of the Los Angeles Section of the American Institute of Electrical Engineers, the following officers were elected for the year 1913-14: Chairman, E. R. Northmore; secretary, C. G. Pyle; assistant secretary, Edward Woodbury; executive committee, J. A. Lighthipe, James E. Barker, George A. Damon, Arthur W. Nye.

Electrical League of Southern California.

At the last meeting of the Electrical League of Southern California held at the Angelus Hotel, on Tuesday, June 10th, Dr. Loye Miller of the State Normal School gave a talk on "Fossil Beds of Rancho La Brea" which was thoroughly enjoyed by all present.

Oregon Electrical Contractors' Association.

The semi-annual meeting of the Oregon Electrical Contractors' Association was held in the hall of the P. R., L. & P. Company, corner of First and Alder streets, Monday evening, June 9th, at 8 o'clock. An illustrated lecture on indirect

illumination by Mr. J. L. Bradfield, northwest representative of the National X-Ray Reflector Company of Chicago, was thoroughly enjoyed by all present. Mr. Murphy, illuminating engineer for the P. R., L. & P. Company, also gave a talk to the members.

Oregon Technical Club.

The regular weekly meeting of the Oregon Technical Club took place, at noon on June 2nd at the Portland Commercial Club. Mr. O. E. Stanley was chairman of the day. Mr. W. H. Crawford spoke on "The Necessity of Every Organization Having an Ideal Towards Which to Work."

Seattle Jovian League.

The meeting of the Seattle Jovian League held at the Rathskeller on Friday, June 6, was largely given over to the cleaning up of unfinished business. The report of the committee having in charge the matter of a proper float for the League during Potlatch week, was accepted and the committee continued with instructions to see after construction of the float or pageant. The resignation of Chairman C. M. Bliven was accepted and R. Worth, northwest manager of the American Ever Ready Company was elected to fill the vacancy. V. A. Weiman of the H. W. Johns-Manville Company was made chairman of the degree team committee. The rejuvenation is to be held some time in September and it was unanimously voted that meetings should be held each Friday instead of taking the regular summer vacation. This was considered necessary in order to make a success of the part to be taken by the league in the forthcoming Potlatch festivities and in order to make sure that enthusiasm will be kept at white heat for the rejuvenation in the fall.

WASHINGTON PUBLIC SERVICE COMMISSION.

The Washington Public Service Commission has decided that the Malden Supply & Power Company and the Rosalia Telephone Company have been excessive in their charges for telephone service. The plant is valued at $6884, reproduction cost, while the telephone system between the two places is valued at $909. The rate for long distance service between the two places has been cut from 15 cents to 10 cents. The 10-cent messenger fee heretofore charged on incoming messages at Malden was ordered eliminated as it was found no messenger service had been provided. Hereafter service must be full 24 hours instead of 15 hours on week days and 7 hours on holidays and Sundays.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

A decision was rendered granting authority to the Southern California Gas Company to issue $750,000 of preferred stock, the proceeds of which will be used for making improvements and for retiring obligations.

The Southern California Edison Company was granted a certificate of public convenience and necessity to construct an electric distribution system in Beaumont.

A decision was rendered granting the application of the Southern California Edison Company to purchase the electric distribution system of the Pacific Electric Company, in Gardena, Moneta, Clifton and Redondo Beach, for $17,500.

A decision was rendered granting authority to the California-Oregon Power Company to buy the electric light and power plant of George H. Johnson, at Sisson, for $15,000.

A decision was rendered granting authority to the California-Oregon Power Company to purchase the electric light plant of R. E. Cavanaugh at Edgewood, Siskiyou County, for $10,000.

An order was issued extending the effective date of the decision in the case of the Oro Electric Corporation during the pendancy of the application for rehearing.

A complaint was filed against the Pacific Gas & Electric Company by the town of Antioch, asking that the commission fix the rates for electricity.

The railroad commission has rendered a decision granting authority to the Los Angeles & San Diego Beach Railway Company to issue notes in the sum of $28,000 to be used in payment for Edison storage battery motor cars to be used on the company's system between San Diego and La Jolla.

The commission has rendered a decision granting the application of J. H. Evans to extend his telephone system into Patterson. The commission disapproved of the original plan of Mr. Evans to discount by 25 per cent all bills paid before the tenth of the month, and recommended instead that the rates should be reduced by 25 per cent. The commission finds that Mr. Evans may levy an excess charge of 10 per cent for all bills not paid before the tenth of the month.

The commission has rendered a decision granting authority to the Pacific Gas & Electric Company to sell to the San Jose Water Comapny certain property and water rights along Los Gatos Creek, Santa Clara county, for $25,000.

The Torrance Water, Light & Power Company has filed an application with the railroad commission asking for authority to issue 50,000 shares of stock and $125,000 of 6 per cent bonds, and to use the proceeds in purchasing the water system recently owned by the Dominguez Land Company and conveyed to Ralph Bennett and E. C. Dicey, trustees.

The San Diego Consolidated Gas & Electric Company has applied to the railroad commission for authority to issue $639,000 of its 5 per cent first mortgage bonds. The proceeds from the sale of the bonds are to be used to pay existing indebtedness and to reimburse the treasury in the sum of $180,000 and the balance of $459,000 is to be used to make the necessary extensions to the company's plant during the year. The company also asks for authority to sell 3148 shares of its capital stock, to be used for the purpose of liquidating its existing indebtedness.

The commission has rendered a decision granting authority to the San Jose Water Company to issue $100,000 in notes. The money is to be used in paying off existing notes in the sum of $46,000, for new construction in the sum of $29,000, and to pay the Pacific Gas & Electric Company for water rights on the Los Gatos Creek in the sum of $25,000.

TRADE NOTES.

The American Electric Company, Seattle, recently installed a 6 kw. generator plant on the ranch of Mrs. Sanders at Ellensburg, Washington.

The Westinghouse Electric & Manufacturing Company, Seattle, has sold to the Issaquah & Superior Coal Mining Company, Ltd., a 300 horsepower, 200 r.p.m., 3-phase, 2200 volt, self-starting synchronous motor, complete with exciter and switchboard, for direct connection to a compressor.

In view of the present relations between the Pacific Coast States and Japan over the legislation against aliens holding land, the shipment which left the East Pittsburgh Works of the Westinghouse Electric and Manufacturing Company last week is of particular interest. This shipment consisted of 25 freight cars loaded with machinery for Japan. It is to be used in connection with the large water-power development of the Inawashiro Hydroelectric Power Company, which is building a large plant about 145 miles from Tokio. The current will be generated at this point, and stepped up to 115,000 volts, which is the highest voltage ever used in Japan. From this point it will be transmitted to the city of Tokio, where it will be used for furnishing light and power. The shipment consisted of eight 4000 k.v.a. and four 150 k.v.a. O. I. C. W. transformers, two motor generator sets and a quantity of switchboard material. The total weight of the shipment was 913,972 pounds.

Miss Russell although but two, wins in the golf tournament having found the nineteenth tee.

C. C. Hillis sizes up the bunch.

You have often met him face to face. He says he's for Albert H. Elliott and the Jobbers first, last and all the time.

Col. Carter takes to the field.

JOBBERS MEET.

It has been said that "it is well men should dwell together in unity." Its fulfillment may be justly applied to the Pacific Coast Jobbers. Their quarterly convention was held at Del Monte from Wednesday to Saturday of last week.

Convention—no, that is hardly the term. It is just one big family gathering; husbands, wives, families, sweethearts and friends, forgetting business or the hum drum of home routine, getting out with Nature, and just being kids again for a few days.

They came from most every quarter of the Pacific Coast to join in the merry-making—from Los Angeles on the south to Portland and Seattle on the north—and when an Eastern friend is due to hit the coast about the time of one of these outings, he usually plans his itinerary so as to drop in in an off-hand sort of way and break bread with the family. If you're not on just get next to jolly Fred Skeel from Syracuse.

What do they do? you ask. Well, they just do everything from batting little white pills all over creation, to doing each other. Unfortunate is he who gets between the pill and creation. They yell "fore" at him till he wishes for a cyclone cellar or a short line to Mars. Besides the golf and pool tournaments, which carried cups for the winners, there were games for the ladies, automobile trips, tennis, billiards and dances in the evening.

The golf tournament aroused much interest and friendly rivalry. One of the most unusual features being that of son playing against father in the finals for Arrow E cup, when it devolved upon H. C. Carter to show daddy how to do it. W. H. Goodwin came out with the lowest gross score, with W. S. Berry next, the latter winning the contractors' cup, according to the stipulations accompanying it, on this record, after six years of "almost won." T. E. Berger was right on the job, taking the Jobbers, Patton and Del Monte cups, the latter being a permanent trophy. The manufacturers' cup was won by S. B. Gregory in the tryout over W. R. Dunbar, his tying opponent, by four strokes. F. N. Averill defeated all opponents in the pool tournament, winning the cup.

	Jobbers and Patton Cups. Net.	Eveready Cup. Net.	Manufacturers' Cup.
W. S. Berry	110	101	
T. E. Berger	90	106	
H. D. Brainard	105	102	
H. V. Carter	106	104	
C. H. Carter	104	97	
J. G. Clapp	...	...	100
W. R. Dunbar	...	...	97
A. H. Elliott	114	102	
W. L. Goodwin	104	109	
N. W. Graham	112	...	
S. B. Gregory	...	...	97
C. C. Hillis	108	108	
P. B. Hyde	...	...	111
T. H. Leggett	97	106	
R. F. Oakes	...	...	100
J. G. Pomeroy	...	115	
S. P. Russell	...	...	102
H. E. Sanderson	...	...	107
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W. L. Goodwin "beating it."

W. S. Berry on the "green" at ninth.

A business meeting was called for Friday morning, 9:30, to arrange for a salmon fishing expedition on Monterey Bay. The fishermen appeared at the appointed hour with "Sandy" coming in by a nose but afterward confessing he would like a moment to locate a strawberry and a cup of coffee. Father Time beat "Buster Cole" to the meeting by a couple of minutes, who likewise pleaded for a couple of minutes to locate a coffee and macaroon. In view of the precarious situation of the two gentlemen, an adjournment was taken, it having leaked out in the meantime that politician Goodwin had all the available supply of boats subsidized. For "ways that are dark and tricks that are," well, leave it to Bill.

Friday evening practically concluded the meeting, the occasion being celebrated by a banquet presided over by H. V. Carter. Addresses were made by many present, the speech of the evening being delivered by Albert H. Elliott, who told for the last time his turntable story. It seemed to be a three-cornered play between Roscoe Oaks, T. E. Berger and H. E Sanderson as to who had the greatest vocal powers, Brewster Hall being the object of their efforts.

Gearheart, Oregon, was selected as the place for the September meeting.

Those in attendance were:

Mr. and Mrs. H. D. Brainard, Western Electric Co., Seattle.
Mr. and Mrs. J. A. Herr, Sprague Electric Works, San Francisco.
Mr. and Mrs. H. N. Lauritzen, Holophane Co., San Francisco.
Mr. and Mrs. F. H. Leggett, Western Electric Co., San Francisco.
Mr. and Mrs. J. G. Pomeroy and daughter, Central Electric Co., Los Angeles.
Mr. and Mrs. R. F. Oaks, Am. Eveready Co., San Francisco.
Mr. and Mrs. H. E. Sanderson, Bryant Electric Co., San Francisco.
Mr. and Mrs. A. G. Young, Telephone & Electric Equipment Co.
Mr. and Mrs. F. N. Averill, Fobes Supply Co., Portland.
Mr. and Mrs. W. B. Hall, Pass & Seymour, San Francisco.
Mr. and Mrs. T. E. Burger, Western Electric Co., Los Angeles.
Mr. and Mrs. C. C. Hillis, Electric Appliance Co., San Francisco.
Mr. and Mrs. J. W. Redpath, Journal of Electricity, Power & Gas. San Francisco.
Mr. and Mrs. S. P. Russell and daughter, H. W. Johns-Manville Co., San Francisco.
W. S. Berry, Western Electric Co., San Francisco.
H. V. Carter, Pacific States Electric Co., San Francisco.
John R. Cole, Manufacturers' Agent, San Francisco.
H. H. Daley, Westinghouse Electric & Mfg. Co., San Francisco.
W. R. Dunbar, Westinghouse Electric & Mfg. Co., San Francisco.
A. H. Elliott, Secretary Jobbers' Assn., San Francisco.
C. L. Gilson, Pacific States Electric Co., Oakland.
W. L. Goodwin, Pacific States Electric Co., San Francisco.
S. B. Gregory, Arrow Electric Co., San Francisco.
C. H. Carter, Pacific States Electric Co., Los Angeles.
P. B. Hyde, Electric Battery Supply Co., San Francisco.
F. H. Murray, National Carbon Co., Los Angeles.
N. W. Graham, Holabird-Reynolds Electric Co., Los Angeles.
C. E. Wiggin, Dunham, Carrigan & Hayden, San Francisco.
E. M. Cutting, Edison Storage Battery Co., San Francisco.
P. B. Clapp, Westinghouse Electric Mfg. Co., Los Angeles.
F. Fowden, Brooks Follis Electric Co., San Francisco.
F. G. Skeel, Crouse Hinds Co., Syracuse, New York.

How we worked(?) at Del Monte. W. L. Goodwin talking it over with Knee-high Wiggin.

ELECTRICAL CONTRACTORS.

The electrical contractors will furnish the entertainment at the meeting of the Electrical Development & Jovian League Tuesday, June 17th. The contractors promise something good and will distribute five useful prizes to the lucky ones.

A neat poster has been distributed among the trade advertising the California State Association's convention at Santa Barbara, August 13-16, 1913.

The General Electric Construction Company was the lowest bidder on the wiring of the Appraisers' Building, at San Francisco, their bid being $8300.

Bids are being received for two 75 kw. generators for the Letterman Hospital at the Presidio, San Francisco.

The National Association have reorganized the California State Association by nominating J. C. Rendles the State President, as third vice-president of the National.

Get Busy.

If you haven't already completed your plans for attending the annual meeting in Chattanooga in July "get busy."

You can't afford to miss this meeting if you take any interest in getting points on improving your business conditions and that of the entire trade.

If you don't go you will feel like the member who failed to attend the last meeting.

The program, which we reprint below, assures you of plenty of time for the business of the organization and also an opportunity for a mighty good time.

On Tuesday, July 15th, the meeting of the Directors and Executive Committee.

On Wednesday, July 16th, the opening of the convention proper. The open session will be at 10 a. m. on the morning of this day with three prominent speakers. A business session will be held at 2 p. m., for members only. At 8 o'clock there will be a reception and dance at the Hotel Patten, and during this reception will be introduced a genuine southern negro cake-walk for large prizes.

On Thursday, July 17th, there will be a business session for members only at 10 a. m. In the afternoon of this day there will be an automobile trip, starting from the headquarters at 2 o'clock, going over the battle fields, Chickamauga Park, and to Fort Ogelthorpe. At the fort there will be a special cavalry drill for the benefit of the convention visitors, which will prove one of the great attractions of the convention for many of the members and guests.

In the evening an illustrated lecture on "Illumination" at 7 p. m., and 9 p. m. a Rejuvenation of the Sons of Jove.

On Friday, July 18th, there will be two business sessions for members, one at 10 a. m., and one at 2 p. m. The ladies and guests will be given an afternoon tea at 3:30 p. m. by the Chattanooga Electric Club. The annual dinner of the association will be held at the Hotel Patten at 8 p. m. on the evening of this day, and will be followed by a very attractive vaudeville performance.

Saturday, July 19th, will be the last day of the convention and will be given up to an outing. At 10 a. m. those attending the convention will leave the hotel for a trip over Waldron's Ridge to Signal Mountain. Lunch will be served at the new Signal Mount Inn at about 12:30, and after lunch the trip will be continued, returning to Chattanooga at 2:30 in the afternoon. The return will be directly to the Union Station and from this point a special train will take the party down to the Tennessee Lock and Dam, where an inspection will be made of this wonderful piece of work. Approximately two hours will be spent at this point and the party will return by a special train, arriving in Chattanooga in time to connect with the evening trains out of the city.

You need the information you will get at the meetings and the association needs your assistance in planning the work for the coming year.—Get Busy!

NEWS NOTES

INCORPORATIONS.

HOLTVILLE, CAL.—No. 3 Water Company has been incorporated with Brawley as headquarters, with a capital stock of $60,000.

LOS ANGELES, CAL.—All electrical interests in Santa Barbara, San Luis Obispo and Fresno counties have been merged into one corporation under the name of the Midlands Public Service Company, with a capital of $2,500,000. W. G. Karchoff, T. C. Balch, Kaspar Cohn, Abe Haas and A. G. Wischon are the incorporators. The companies taken over are the Russell Robinson Water & Electric Company, at Rio Grande; the plant at San Miguel; Coalinga Water & Electric Company; Paso Robles Gas & Water Company; Midland County Company at Santa Maria and San Luis Obispo. The new corporation will secure electric power from the San Joaquin Light & Power Company, which has been extending its lines into this territory, and will devote special attention to the development of agricultural lands by furnishing power for pumping.

ILLUMINATION.

BERKELEY, CAL.—The city council has awarded the contract for lighting the streets and public buildings of Berkeley to the Pacific Gas & Electric Company.

GLENDALE, CAL.—At a recent election held at Casa Ferdugo and North Glendale, it was voted that these two localities should be formed into an electric lighting district.

OROVILLE, CAL.—The supervisors have granted the Great Western Power Company a franchise in Butte county, giving it the right to erect power poles and string wires.

PUYALLUP, WASH.—Aswell Bronfield has been engaged to investigate conditions and report on the feasibility of constructing a municipal hydroelectric plant at Salmon Springs.

LOS ANGELES, CAL.—The board of supervisors has let the contract to the Pacific Light & Power Company for the installation of street lamps along Laurs Canyon road, from Sunset boulevard to Lookout Mountain Park.

REEDLEY, CAL.—A. W. Webber and R. W. Wilson, of the Alta District Gas Company, have asked the Reedley trustees to advertise for a gas franchise for sale. The company offers to install a system if given a 25-year franchise.

CLATSKAINE, ORE.—The electric light plant has been purchased by a Tacoma, Wash., company, which will practically rebuild the plant. About $6,000 will be expended in the reconstruction and installation of new machinery.

HONOLULU, H. T.—United States engineers' office, Honolulu, will receive bids for a 70 ft. steel searchlight tower of the Scherzer type, until July 5th. Information may be obtained from Thos. H. Rees, customs house, San Francisco.

SEATTLE, WASH.—The only bid received by the city for $1,700,000 general municipal bonds has been rejected by the council. Bids were asked for $975,000 refunding bonds, $425,000 light extension bonds and $300,000 water extension bonds.

SAN FRANCISCO, CAL.—Luminous arc standards, 55 ft. in height and furnishing from 8000 to 10,000 candle power, will be one of the mediums through which the Panama-Pacific exposition will be illuminated. These lights will be shaded by ornamental banners of canvas eight feet across.

SALEM, ORE.—The State Railroad Commission has given notice of an exhaustive inquiry into all the rates of the Portland Railway, Light & Power Company for electric lighting, heating and power in all the cities and towns in which it operates. The rates to be subjected to the acid test are those now applying in Portland, Salem, Oregon City, Milwaukie, St. Johns, Linnton, Gladstone, Gresham, Lents, Boring, Estacada, Troutdale, Fairview, Oswego, Woodburn, Silverton, Mount Angel and Gervias and the territory served in the vicinity of these towns by the company's lines.

TRANSMISSION.

HOLTVILLE, CAL.—It is reported that a proposition is under consideration providing for the Holton Power Company building a power line from Imperial valley into Coachella valley.

CLEAR LAKE, CAL.—The Power and Irrigation Company filed a suit in the United States District Court to condemn lands in T. 12 N. and 7 W. and 13 N. and 7 W., for a dam site near the outlet of Clear Lake, the object being to convert the body of water into a reservoir for irrigation and power purposes.

TACOMA, WASH.—The city has started construction of 20 miles of pole line to connect the present double line with the distributing station in the city. Ten miles of this line has been constructed from the headworks, paralleling the line already in existence, which will be transferred to the new pole line.

SPOKANE, WASH.—Mining men of Coeur d'Alene anticipate that within 18 months the Montana Power Company, now preparing to erect a power plant at Thompson Falls, Mont., will invade the Coeur d'Alene District in competition with the Washington Water Power Company, which now furnishes power to practically all the operating mines in that locality.

OROVILLE, CAL.—That the Oro Electric will probably resume construction work on its plant at Humbug within the next 60 days was the statement of R. L. Van Der Naillen, general manager of the company. Van Der Naillen states the many small difficulties, which forced a temporary cessation in the construction work, have been surmounted, and when work is started once more it will go to a successful completion.

SEATTLE, WASH.—H. A. Eastman of Seattle has offered to that city a power project on White River for the sum of $250,000. It is claimed that it is capable of producing 100,000 h.p. at much less cost than either the Hebb project on the White River, offered to the city at $1,000,000, or the Lake Cushman project offered to the city at $640,000. The council will make examination of same in connection with the Lake Cushman proposal.

HOOD RIVER, ORE.—The Hydroelectric Company of Hood River has been sold to the Pacific Power & Light Company, which operates plants in many towns in Washington and Oregon, for a consideration of $125,000. The property sold includes water rights representing a possible development of 6000 horsepower. The purchase is the amicable outcome of a bitter warfare, both commercial and legal, which has been waged by the two companies for several years.

TRANSPORTATION.

SAN DIEGO, CAL.—The Los Angeles & San Diego Beach Railway Company has applied to the commission for authority to issue car-trust notes to the amount of $28,000.

SAN FRANCISCO, CAL.—The finance committee of the supervisors has recommended an appropriation of $5000 for the use of the city engineer for drawing the detailed plans and specifications for the proposed new electric railways.

VALLEJO, CAL.—That the Napa Valley electric line is endeavoring to enter the Benicia field is the statement by those who are in a position to be authorities. It is stated that President Irvine himself is interested in this extension. His idea is to have a connecting link from Vallejo, which will bring this city close to the Oakland-Antioch line.

SAN FRANCISCO, CAL.—The Southern Pacific Company has applied to the railroad commission for authority to issue $30,000,000 5 per cent collateral trust notes. The notes are to be dated June 1, 1913, and will be subject to redemption at par with interest on June 1, 1913, and December 1, 1914, upon 30 days' notice. Of this amount, about $3,000,000 will be spent on the transbay electric and ferry system.

SAN FRANCISCO, CAL.—The construction of the western extension of the Geary street railroad is proceeding with due celerity. The Healy-Tibbitts Company has already laid the ties and rails of the double track from Geary street and Thirty-third avenue, to the beach, and now has to fill in and macadamize the roadbed. The J. G. Sutton Company, which has the contract for the overhead construction, has completed its work, with the exception of stringing the trolley wires.

FRESNO, CAL.—The Fresno Traction Company, through F. E. Cook, has applied to the supervisors for a franchise over the county road, a distance of three-quarters of a mile north of the corner of Wishon and McKinley avenues, for the new line to be built to the San Joaquin River. While the total length of the line will be about ten miles, this three-quarters of a mile will be the only portion that does not go over private right of way, deeded to the traction company. The preliminary survey for the new road is practically completed.

OAKLAND, CAL.—"There is absolutely no truth to the report that the Oakland & Antioch has surveyors in the field for a line from Sacramento to Colfax," said Samuel Naphthaly, representing the Oakland, Antioch & Eastern Railroad. He spoke in answer to the published report that Oakland and Antioch men are busy north of this city, surveying a line to connect the Nevada County Narrow Gauge Railroad, recently purchased by the Oakland-Antioch with the terminus of the regular line from the bay here.

SAN FRANCISCO, CAL.—The public utilities comimttee of the supervisors has fixed August 26th as a tentative date for the election for the $3,500,000 bond issue for municipal railway extensions. This is subject to the approval of the supervisors. It was practically decided also that the interest rate shall be 5 per cent and that part of the issue shall be in $100 and $500 denomination so that the city treasurer may be able to sell a large proportion of the offering over the counter to small investors.

TELEPHONE AND TELEGRAPH.

ALTURAS, CAL.—An application has been made by the Dent Telephone & Telegraph Company to the board of supervisors for a franchise to operate a telephone and telegraph system from Ft. Bidwell to the state line of California and Oregon. Sealed bids will be received up to July 21st for the sale of the franchise.

SAN FERNANDO, CAL.—Transfer of business of Maclay Rancho Water Company to the Consolidated Securities Company has been completed and the latter company is now in complete control of local telephones and water systems. Among the improvements contemplated is the erection of a new telephone exchange building.

RICHMOND, CAL.—The installation of a fire alarm and police telegraph system covering the entire city at a cost of $28,500 has been ordered by the city council and the clerk has been authorized to sign a contract with the Gamewell Fire Alarm & Telegraph Company for the installation of a system according to the plans and specifications submitted.

SAN FRANCISCO, CAL.—The Pacific States Telephone & Telegraph Company within the jurisdiction of the State of California has been notified by the State Board of Railroad Commissioners to appear before the commission June 27 and explain why rates and charges in the interchange of telephone service in the state should not be regulated.

WATERWORKS.

CAMPBELL, CAL.—The Campbell Water Company has applied to the commission for authority to issue $25,000 in stock, representing the investment of new capital in the business.

OLYMPIA, WASH.—The city council has passed an ordinance calling for an election July 21 on the question of bonding in the sum of $150,000 to construct a municipal water system.

MONTEREY, CAL.—The Carmel Development Company has sold the Carmel Water Works to the Monterey County Water Company. The system will be entirely remodeled and improved.

OXNARD, CAL.—A contract for the construction of a municipal water system has been let for $89,815 to C. D. Vincent of Oakland and H. N. Tracy Company of Los Angeles on combined bid. Work will begin at once.

OAKLAND, CAL.—The supervisors have called a special election for July 29th to submit to voters the proposition of organizing a water district including Oakland, Berkeley, Alameda, Emeryville, Albany, Piedmont and San Leandro.

MILWAUKIE, ORE.—The city will not purchase the two water plants, the Fisch plant and the Minthorn Springs, but will sell the $20,000 water bonds and proceed to erect a new plant. The bonds carry 5 per cent interest and run twenty years.

PORTLAND, ORE.—Plans are being prepared by Louis C. Kelsey, consulting engineer, for a complete water system to be installed at Amity, Ore. The plant will consist of a pumping plant and distributing system. The work is estimated to cost $25,000.

SAN FERNANDO, CAL.—The Consolidated Securities Company, which recently acquired the domestic distributing water system of Maclay Rancho Water Company, has submitted a proposition to the board of trustees to sell the water plant to the city for $50,000.

RIVERSIDE, CAL.—The bid of the First National Bank of Riverside for $600,000 worth of municipal water bonds was received and accepted by the city council. The purchaser also took an option for four months on the remainder of the $1,600,000 issue. The domestic water plant of the Riverside Water Company will be taken over by the city with the proceeds of the bond sale.

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company has applied to the commission for authority to purchase certain water rights, flumes, etc., from the United Water and Power Company in the vicinity of Gold Run, Placer county. The water and flumes are to be used by the Pacific company in connection with its power projects on the Bear River canal.

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